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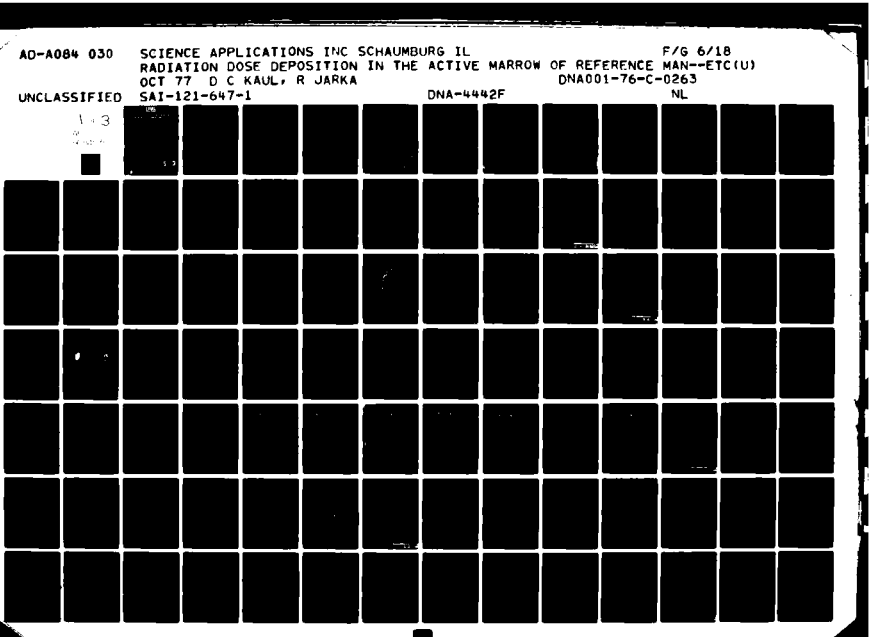

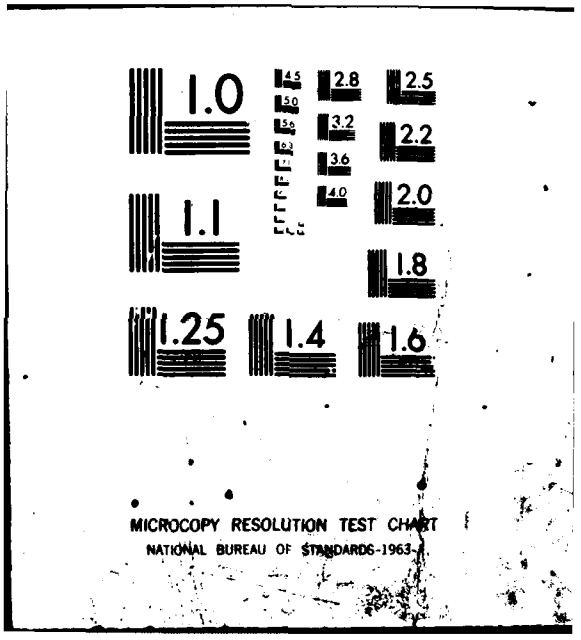
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RADIATION DOSE DEPOSITION IN THE ACTIVE MARROW OF REFERENCE MAN

Science Applications, Inc.
1701 E. Woodfield Road, Suite 819
Schaumburg, Illinois 60195

31 October 1977

Final Report for Period May 1976—October 1977

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Reference Man	Gamma Ray
Bone Marrow	MORSE Computer Code
Radiation Dose	Combinatorial Geometry

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Dose Deposition in the active bone marrow of reference man was calculated using the MORSE Monte Carlo transport Code in the adjoint mode. Calculations were made in a three region reference man phantom described in Combinatorial Geometry. Calculations were performed using cross sections and KERMA factors from the 37 neutron-21 gamma ray group DNA Few Group Library. KERMA factors used in the calculation of dose were those for the constituents of active marrow alone for neutron dose and active marrow

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19. KEY WORDS (Continued)

DNA Few Group Library
KERMA Factor
Cross Section
Adjoint Radiation Transport

20. ABSTRACT (Continued)

plus trabecular bone constituents for photon dose. Dose deposition (or response) functions (rad (marrow) per unit incident radiation fluence) are tabulated in energy differential and angle integral and differential form for gamma ray dose from incident gamma rays and for neutron and gamma ray dose from incident neutrons. Tabulations are for eight skeletal regions and for reference man. The dose deposition factors have been used to determine marrow dose from hypothetical contemporary weapon types and for Little Boy and Fat Man.

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SECTION I

INTRODUCTION

This report presents the method and results of calculations of human marrow dose deposition from energy and angular-differential neutron and gamma ray fluences incident on the human body. Marrow dose is of interest due to its apparent relationship to the early mortality effect in mammals, subsequent to their exposure to radiation of the type produced by nuclear weapon detonations and other sources. A comprehensive review of this effect has been performed as part of the Reactor Safety Study (1). According to references cited in that study: "It is generally believed that damage to the bone marrow is the most important contributor to early death from large doses to the whole body. That is, radiation damage to the lung or to the gastrointestinal tract is not likely to be lethal unless accompanied by bone marrow damage." Thus, dose to the bone marrow is considered to be crucial in determining mortality probability in a subject who has suffered marrow, lung, gastrointestinal tract and other damage as a result of whole body exposure to an external radiation source. The effects of such damage are collectively referred to as the acute marrow syndrome and can produce death within 30 to 60 days subsequent to a single, short-duration exposure in the range of a few to several hundred rads (tis) free-in-air (FIA).

Accident, clinical and atomic bomb survivor data have been used to estimate the dose-effect relationship for death resulting from the acute marrow syndrome. The relationship is depicted in Figure I-1 for the cases of minimal, supportive and heroic post exposure medical care. Minimal care may be taken to mean the treatment of symptoms and maintenance of patient comfort; supportive care includes the use of antibiotics to bolster the body's defenses against infection, and heroic care refers to such extremes

as bone marrow transplants. Most available data is relevant to the minimal care case. Therefore, the marrow dose required for a 50% probability of death (LD_{50}) in such cases, which has a value of 340 rad (marrow), may be used with high confidence to an accuracy of $\pm$10%. It should be noted, however, that confidence in such accuracy applies only to instances of whole body irradiation with low LET[1] radiation; i.e., the same type which forms the basis for the above dose-mortality criterion.

Neutrons, which deposit their energy mainly through the production of heavy, charged (high LET) particles have been shown to be more effective in producing biological damage per unit dose deposition than are low LET particles. In one experiment (2) involving the comparison of the response of dogs to gamma rays and mixed gamma ray-fission neutron exposure, the relative biological effectiveness (RBE) per unit marrow dose between neutrons and gamma rays in producing death was estimated as 1.4. However, other studies have shown such RBE's for various types of tissue cell damage to be dependent both on neutron fluence intensity and energy spectrum. Specifically, studies by Katz, et al., (3) indicate that for doses in excess of 100 rad (marrow) the RBE for reproductive incapacitation of mouse marrow cells is 4 and 3 for 0.43 MeV and 1.5 MeV neutrons respectively and that these RBE values rise exponentially with decreasing dose below 100 rad (marrow). Because of this potential for increased biological effectiveness per unit dose of neutrons over that of gamma rays, neutron dose and neutron-induced gamma ray dose to the marrow are tabulated separately in this report.

[1]Linear energy transfer (LET) is a measure of the rate of energy loss along the track of an ionizing particle, expressed in units of energy per unit track length (thousands of electron volts per micron). Low-LET radiation includes beta particles and gamma rays; high-LET radiation includes alpha particles and protons and, hence, particles such as neutrons which are likely to produce them.

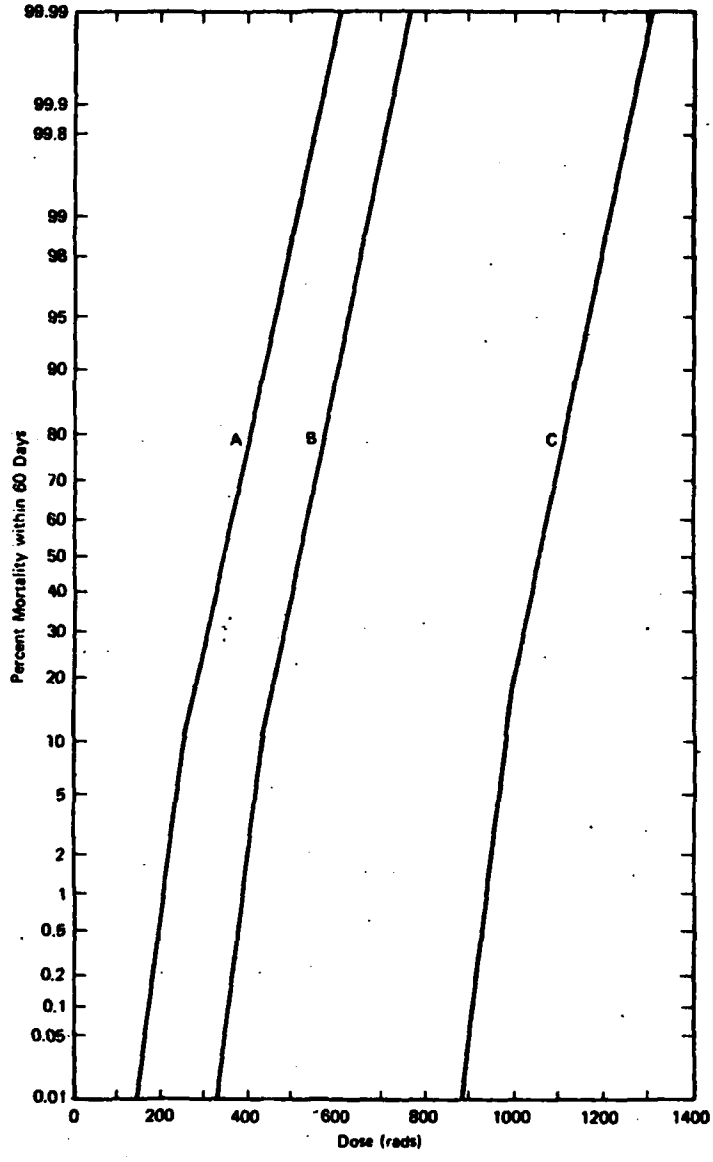


Figure I-1

Estimated dose-response curves for 50% mortality in 60 days with minimal treatment (curve A), supportive treatment (curve B), and heroic treatment (curve C).

The balance of this report is written in four major sections, plus references, and appendices, which mainly contain tabulations of calculated data. Of the major sections the first contains a brief description of the radiation transport computation technique and computer code, a discussion of the origin and preparation of the multigroup radiation reaction cross sections and energy deposition factors, a description of the man phantom model, and the development of a rationale for and definition of human active marrow dosimetry for incident neutron and gamma radiation. The second major section describes the energy and angular differential results of the radiation transport calculations in terms of marrow dose (rad (marrow)) per unit incident fluence. The third presents integral marrow doses calculated for exposure to radiation from typical tactical weapon types and yields, as well as for the Little Boy and Fat Man devices. The final substantive section of this report contains a summary of major study findings and attempts to place these findings in perspective, especially with regard to the prediction of mortality probability from the acute marrow syndrome.

SECTION II
RADIATION TRANSPORT MODELS

THE CODE

The marrow dose calculations have been performed using the radiation transport code MORSE (4,5). MORSE (Multigroup Oak Ridge Stochastic Experiment) is a multigroup neutron and gamma ray transport Monte Carlo code that may be used to solve coupled neutron-gamma ray problems in either the forward or adjoint mode.

Monte Carlo calculations in the forward mode may be likened to an analytical radiation transport experiment conducted according to the rules of the Boltzman equation, in which a neutron or gamma ray is started at some source location, according to a predetermined energy distribution, followed through interactions with the surrounding media until it arrives in an energy-degraded state at the detector volume of interest and is scored as contributing to the energy deposition (dose) in that volume according to the energy of the radiation and the nature of the detector material. Calculations in the adjoint mode may be thought of as proceeding in the reverse order, with radiation particles started in the detector according to the energy distribution of the detector response, effectively gaining energy through interactions with surrounding media, and being scored as they enter a source region of interest. In the MORSE code this is accomplished for a coupled neutron-gamma ray transport problem by inverting the group-to-group transfer matrix. In such an inverted matrix neutrons and gamma rays may be thought of as gaining instead of losing energy, and gamma rays effectively produce secondary neutrons.

The advantage of the adjoint process lies in its efficiency in treating a finite number of localized detector regions receiving dose from a distributed external radiation source. If the source region is defined as that outside a simply defined surface (usually a sphere) about the detector and its immediate surroundings, the record of particles escaping through that surface away from the detector (the adjoint fluence) represents the dose deposition characteristics (response) of the detector weighted by the transport properties of the surrounding media. Thus, a fluence incident on the exterior of the surface may be scored according to the characteristics of the adjoint fluence to obtain the dose at the detector. In an adjoint calculation parameters usually recorded at the coupling surface are particle type, energy and direction cosine. Because of the difficulty in obtaining good statistics in such a problem, the location of the exit point on the surface is usually not recorded. Thus, a condition for the use of the adjoint results is that the fluence be uniform in its energy and angular dependence over all cross sections of the coupling surface.

THE CROSS SECTIONS AND KERMA FACTORS

Cross sections used in the calculations were taken from the Defense Nuclear Agency (DNA) Few Group Coupled Neutron-Gamma Ray Cross Section Library (6). The library was prepared for general use by ORNL using the AMPX code (7) and is derived from cross section data contained in the DNA Working Cross Section Library (8) and the Evaluated Nuclear Data File (ENDF) (9). The origin of data for each element in that library is given in Table II-1.

The cross sections were used in the 37 neutron group--21 gamma ray group structure provided by the library. Energy boundaries for this group structure are given in Table II-2. Cross section data were processed into this group structure using a 1/E weighting spectrum for all neutron groups except the thermal group, for which a 300°K Maxwellian weighting spectrum was used. The thermal cross section for hydrogen has been adjusted to account for its bound state in water. Scattering angular dependence is provided by coefficients of a P_3 Legendre expansion.

Dose deposition was determined using Kinetic Energy Released in Material (KERMA) factors calculated with the MACK code (10) and based on the same ENDF format data as are the multigroup cross sections. These KERMA factors are provided as part of the DNA Few Group Library, which contains multigroup KERMA values for a number of simple and compound materials as given in Table II-3.

In reviewing the published KERMA values, it was found that those for thermal neutrons (Grp 37) were not consistent with the cross section values for that group, being larger by a factor of 11.74 than KERMA calculated by hand directly from the cross sections. This problem was discussed with the authors of the DNA Few Group Library, and it was determined that they had produced the KERMA

using a straight 1/E weighting instead of the 300°K Maxwellian used to produce the cross section values. KERMA values used in this project for materials listed in Table II-3 have been adjusted to account for the Maxwellian weighting of the thermal group.

Table II-1 Data Description for the Defense Nuclear Agency Few-Group Cross-Section Library

Material	Evaluators	Date	DNA MAT-MOD	ENDF/B-IV Equivalent
H	Stewart, LaBauve, Young - LASL	10/73	4148-2	1269
H-3	Stewart - LASL	10/73	4169-1	1169
Li-6	Battat, LaBauve - LASL	1974		1271
Li-7	Battat, LaBauve - LASL	1974		1272
Be-9	Howerton, Perkins - LL	1973	4154-3	1289
B-10	LaBauve, Young, Hale - LASL	1972		1159*
B-11	LaBauve, Young, Hale - LASL	1973		1160*
C-12	Perey, Perey - ORNL	2/74	4274-0	1274
N	Young, Foster - LASL	7/73	4133-4	1275
O	Young, Foster - LASL	8/73	4134-2	1276
F	Fu, Larson, Perey - ORNL	9/74	4509-1	1277
Na	Paik, Pitterle, Perey - WARD, ORNL	2/72	4156-0	1156
Mg	Drake, Fricke - SAI	2/74	4512-1	1280
Al	Foster, Young - LASL	11/73	4135-3	1193
Si	Larson, Perey, Drake, Young - ORNL	2/74	4151-3	1194
P	Howerton - LLL	2/76		7121**
S	Howerton - LLL	2/76		7122**
Cl	Drake - GGA	1967		1149
K	Drake - GGA	1967		1150
Ca	Fu, Perey - ORNL	2/73	4152-3	1195
V	Penny, Owen - ORNL	9/72		1196
Cr	Prince - BNL	4/74		1191
Mn	Takahashi - BNL	2/74		1197
Fe	Perey, Fu, Penny, Kinney, Wright - ORNL	2/74	4180-2	1192
Ni	Bhat - BNL	12/73		1190
Cu	Drake, Fricke - SAI	2/74	4529-1	1295
Mo	Howerton - LLL	9/74		1287
Ta-181	Howerton, Perkins, MacGregor - LLL	10/73	4179-3	1285
W-182	Young - LASL	3/74	4582-2	1128
W-183	Young - LASL	3/74	4583-2	1129
W-184	Young - LASL	3/74	4584-2	1130
W-186	Young - LASL	3/74	4586-2	1131
Pb	Fu, Perey - ORNL	10/73	4136-5	1288
U-235	Howerton, MacGregor - LLL	3/73	4188-1	
U-238	Howerton, MacGregor - LLL	3/73	4187-1	
Pu-239	Stewart, Hunter - LASL	3/73	4539-0	
Pu-240	Stewart, Hunter - LASL	3/73	4540-0	

*Secondary gamma-ray production cross sections processed with POPOP4.
**not officially in ENDF/B-IV

Table II-2 NEUTRON AND GAMMA-RAY ENERGY BOUNDARIES FOR THE 37-21 COUPLED NEUTRON-GAMMA LIBRARY

Group No.	Neutron Group (eV)		Gamma Group (eV)	
	Energy	Lethargy	Energy	Eff. Avg.
1	1.96+7*	-0.675	1.40+7	1.20+7
2	1.69+7	-0.525	1.00+7	9.00+6
3	1.49+7	-0.400	8.00+6	7.50+6
4	1.42+7	-0.350	7.00+6	6.50+6
5	1.38+7	-0.325	6.00+6	5.50+6
6	1.28+7	-0.250	5.00+6	4.50+6
7	1.22+7	-0.200	4.00+6	3.50+6
8	1.11+7	-0.100	3.00+6	2.75+6
9	1.00+7	0.000	2.50+6	2.25+6
10	9.05+6	0.100	2.00+6	1.75+6
11	8.19+6	0.200	1.50+6	1.25+6
12	7.41+6	0.300	1.00+6	8.50+5
13	6.38+6	0.450	7.00+5	5.75+5
14	4.97+6	0.700	4.50+5	3.75+5
15	4.72+6	0.750	3.00+5	2.25+5
16	4.07+6	0.900	1.50+5	1.25+5
17	3.01+6	1.200	1.00+5	8.50+4
18	2.39+6	1.433	7.00+4	5.75+4
19	2.31+6	1.467	4.50+4	3.75+4
20	1.83+6	1.700	3.00+4	2.50+4
21	1.11+6	2.200	2.00+4	1.50+4
22	5.50+5	2.900	1.00+4	
23	1.58+5	4.150		
24	1.11+5	4.500		
25	5.25+4	5.250		
26	2.48+4	6.000		
27	2.19+4	6.125		
28	1.03+4	6.875		
29	3.35+3	8.000		
30	1.23+3	9.000		
31	5.83+2	9.750		
32	1.01+2	11.500		
33	2.90+1	12.750		
34	1.07+1	13.750		
35	3.06+0	15.000		
36	1.13+0	16.000		
37	4.14-1	17.000		
38	1.00-5	27.631		

*Read as 1.96×10^7.

Table II-3 RESPONSES INCLUDED WITH THE 37-21 LIBRARY

Response Function	Units
Neutron Free-in-Air Tissue Kerma	Rads/(Neutron/cm^2)
Gamma Free-in-Air Tissue Kerma	Rads/(Neutron/cm^2)
Neutron Displacement in Silicon	(Equiv. 1-MeV Neutrons/(cm^2·sec))/ Neutron/(cm^2·sec)
Neutron Ionization in Silicon	(Rads-Si)/(Neutron/cm^2)
Gamma Ionization in Silicon	(Rads-Si)/(Photon/cm^2)
Snyder-Auxier Neutron Tissue Dose	Rads/(Neutron/cm^2)
Claiborne-Trubey Gamma Tissue Dose	Rads/(Photon/cm^2)
H Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
C Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
N Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
O Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Na Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Mg Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Al Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Si Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
P Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
S Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Cl Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
K Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Ca Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
Fe Neutron Kerma	(Rads/Atom)/(Neutron/(cm^2·g))
H Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
C Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
N Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
O Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Na Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Mg Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Al Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Si Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
P Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
S Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Cl Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
K Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Ca Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Fe Gamma Kerma	(Rads/Atom)/(Photon/(cm^2·g))
Snyder-Neufeld Neutron Tissue Dose	Rads/(Neutron/cm^2)
Henderson Neutron Free-in-Air Tissue Kerma	Rads/(Neutron/cm^2)
Henderson Gamma Free-in-Air Tissue Kerma	Rads/(Photon/cm^2)
Snyder-Auxier Neutron Tissue Dose	Rem/(Neutron/cm^2)

THE MAN PHANTOM

The man phantom used as the radiation transport model in the calculation is based on that described by Snyder et al (11). That phantom has been compared to the specifications for reference adult man as reported in ICRP 23, Report of the Task Group on Reference Man (12), and found to be very similar. A detailed comparison is given in Table II-4. The external surface configuration of the phantom is shown in Figure II-1. Internal detail includes skeleton and lungs only, the remainder being homogenized to a single uniform soft tissue material. Elemental compositions (% by weight) of tissues for these three regions are given in Table II-5

The external and internal configurations of the phantom as described by Snyder et. al. were translated into combinatorial geometry suitable for use with the MORSE Code. The mathematical prescriptions for these details are given in Appendix A of this report. The combinatorial geometry phantom was tested to insure that all component placement was as desired and that no undefined regions existed. Testing was done using the PICTURE module of MORSE in the course of which a number cross sectioned views of the phantom were produced. These are presented in Figure II-2 through II-10

The numeric and alphabetic code by which the various body regions of the phantom may be identified is identical for all 9 figures and is given on the following page.

Code	Phantom Body Region
1	Soft Tissue, Head
2	Soft Tissue, Trunk
3	Soft Tissue, Legs
4	Soft Tissue, Genitals
5	Lung Tissue, Left Lung
6	Lung Tissue, Right Lung
7	Skeletal Tissue, Spine and Skull
8	Skeletal Tissue, Arms
9	Skeletal Tissue, Legs
A	Skeletal Tissue, Pelvis
B	Skeletal Tissue, Ribs
C	Skeletal Tissue, Clavicles
D	Skeletal Tissue, Scapulae
E	Volume External to the Phantom

Table II-4 Body Organ Specifications for the MIRD (Snyder) Phantom and those from the Reference Man Report

Body Organs	Mass (g)	
	Reference Man Report	Phantom
Adrenals	14	15.5
Bladder	45 wall; 200 contents	45.13 wall; 200 contents
Gastrointestinal tract		
stomach	150 wall; 250 contents	150 wall; 246.9 contents
small intestine-contents	640 wall; 400 contents	1044 wall plus contents
upper large intestine	210 wall; 220 contents	109.2 wall; 220 contents
lower large intestine	160 wall; 135 contents	160.1 wall; 136.8 contents
Kidneys (both)	310	284.2
Liver	1,800	1,809
Lungs (both, with blood)	1,000	999.2
respiratory lymph nodes	15	15
Other tissue	48,000	48,480 (28,000 g suggested for muscle; 12,500 g for separable adipose tissue)
Ovaries (both)	11	8.268
Pancreas	100	60.27
Skeleton	10,000	10,470
cancellous bone	1,000	1,000
cortical bone	4,000	4,000
red bone marrow	1,500	1,500
yellow bone marrow	1,500	1,500
Skin	2,600	2,833
Spleen	180	173.6
Testes	35	37.08
Thymus	20	24.8
Thyroid	20	19.63
Uterus	80	65.4
Total body	70,000	69,880

Table II-5 Elemental Composition of Different Tissues of the Phantom (% by weight)

Element	Skeletal Tissue[a]	Lung Tissue[b]	Total Body Minus Skeleton and Lungs[c]
H	7.04	10.21	10.47
C	22.79	10.01	23.02
N	3.87	2.80	2.34
O	48.56	75.96	63.21
Na	0.32	0.19	0.13
Mg	0.11	7.4×10^{-3}	0.015
P	6.94	0.081	0.24
S	0.17	0.23	0.22
Cl	0.14	0.27	0.14
K	0.15	0.20	0.21
Ca	9.91	7.0×10^{-3}	0
Fe	0	0.037	0

[a]Density 1.4862 g/cm^3 [b]Density 0.2958 g/cm^3

[c]Density 0.9869 g/cm^3

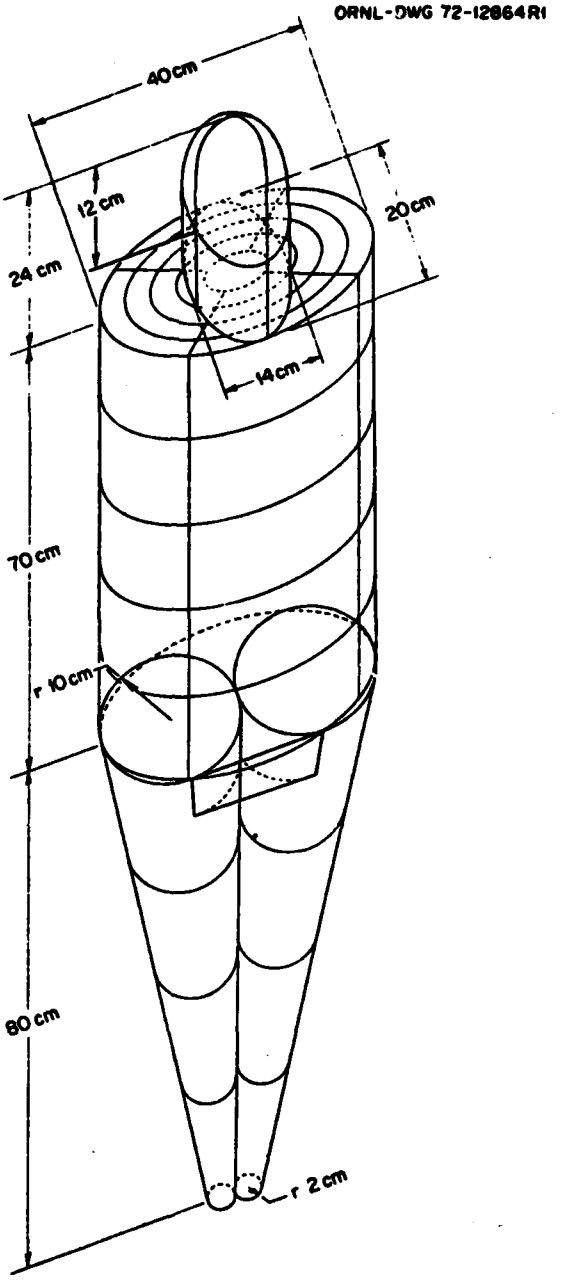


Fig. II-1 The adult human phantom.

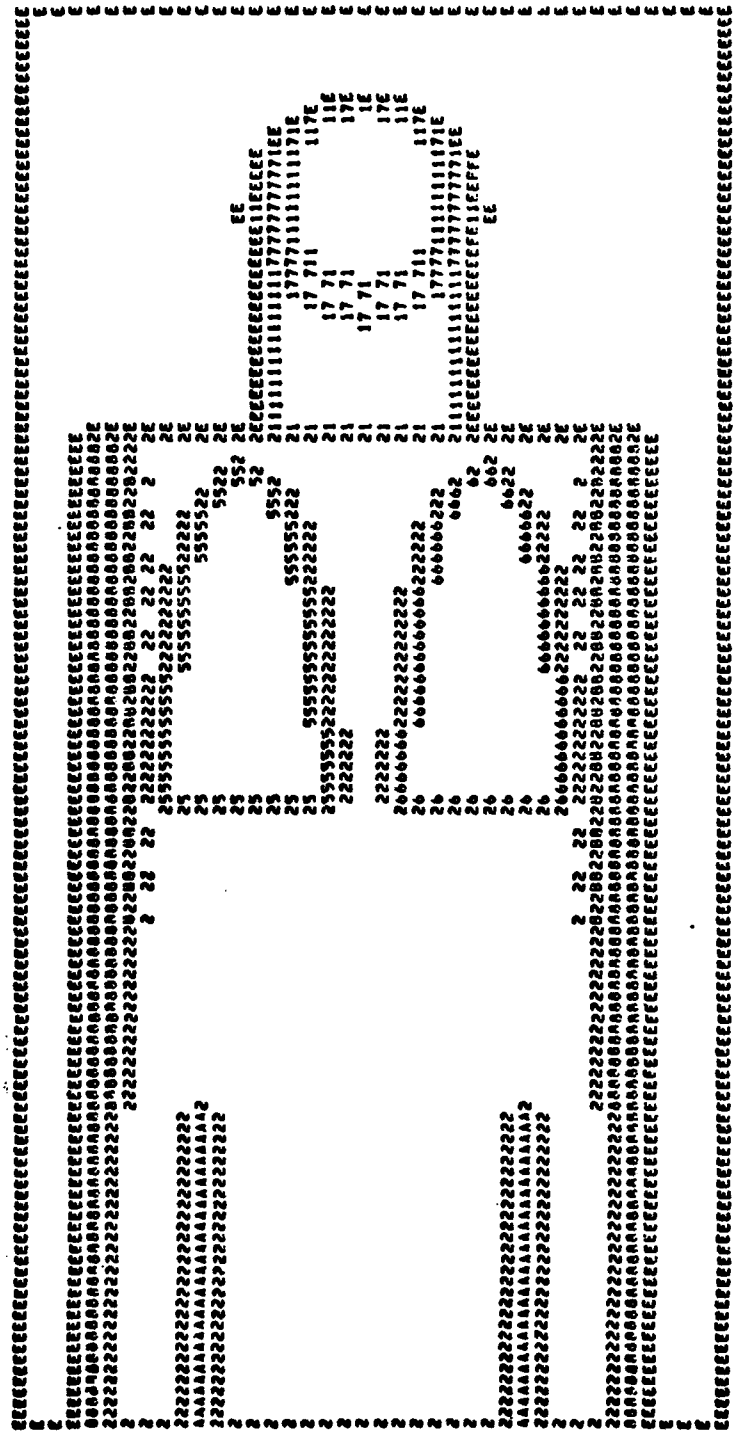


Figure II-2 Reference Man Phantom In
Combinatorial Geometry In the
X-Z Plane at Y=0

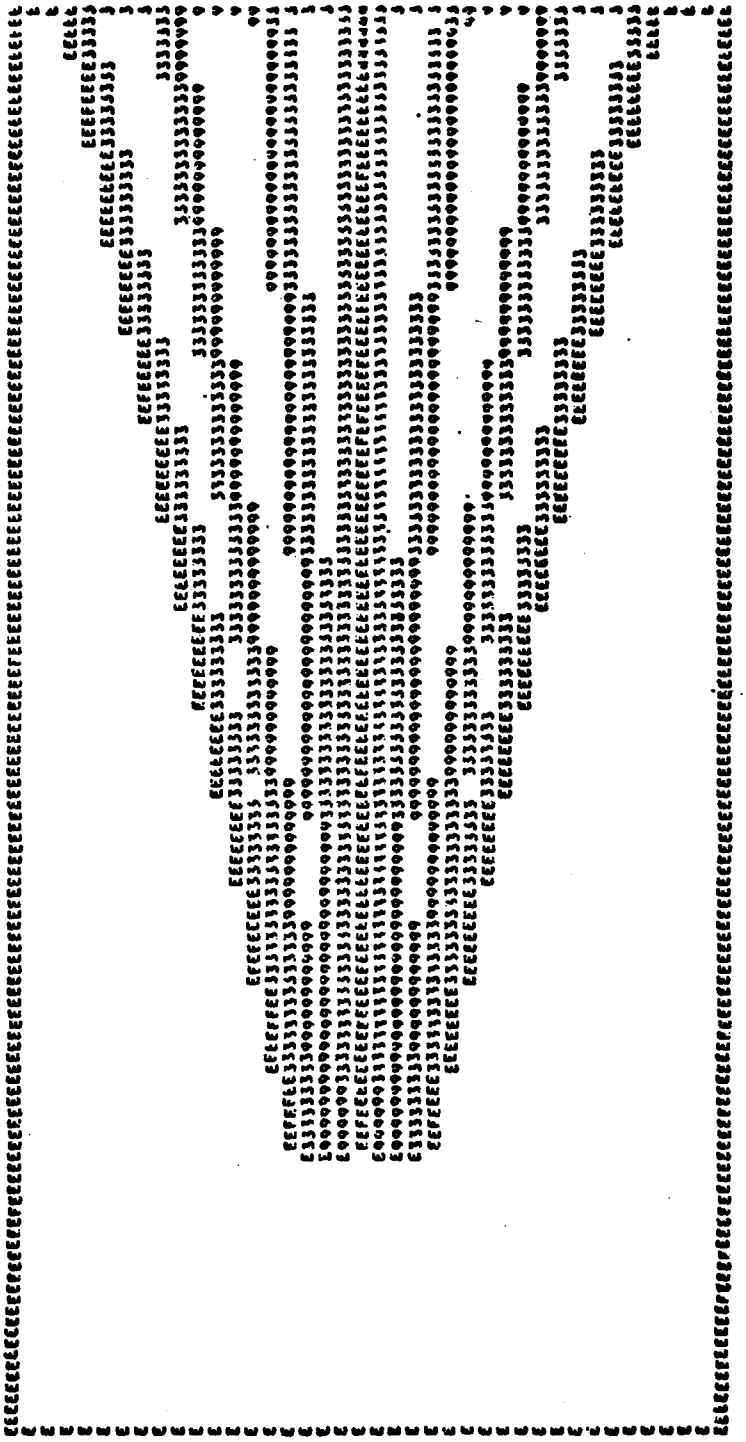


Figure II-2 (continued)

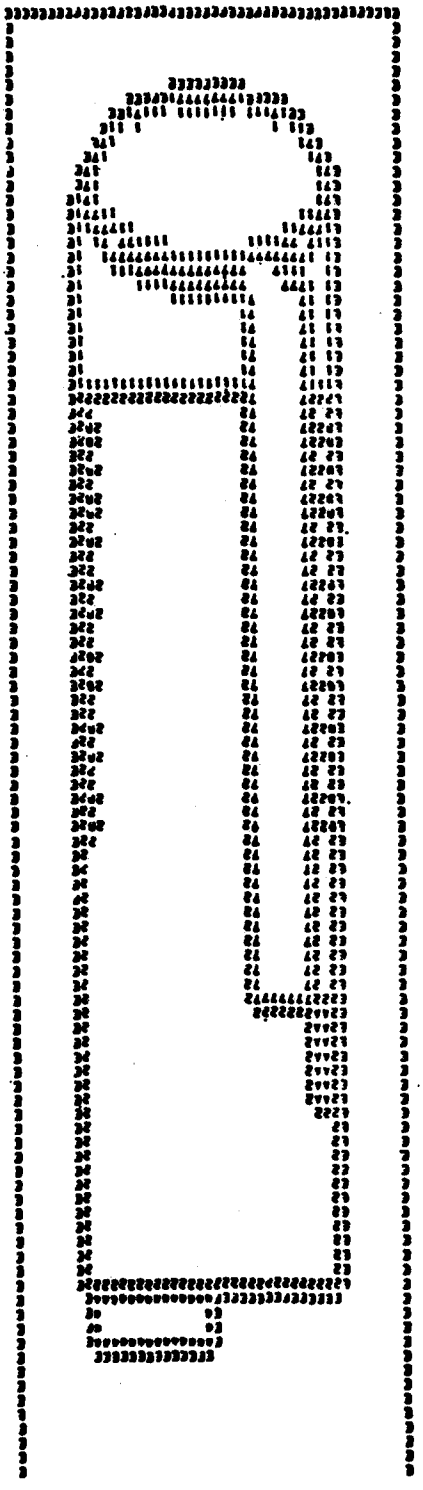


Figure II-3 Reference Man Phantom In
Combinatorial Geometry In the Y-Z Plane
at X=0

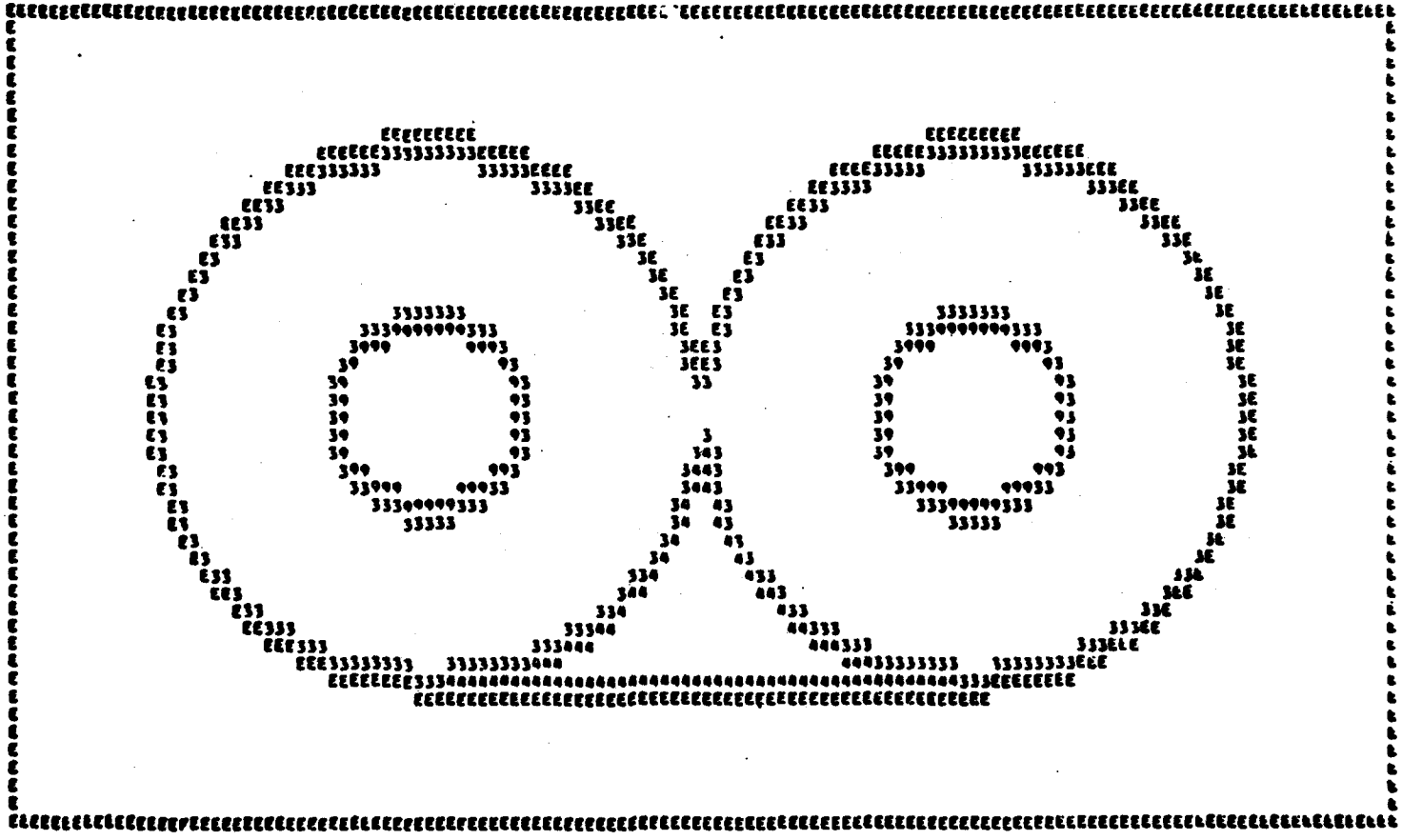


Figure II-4 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=-2 (legs and genitals)

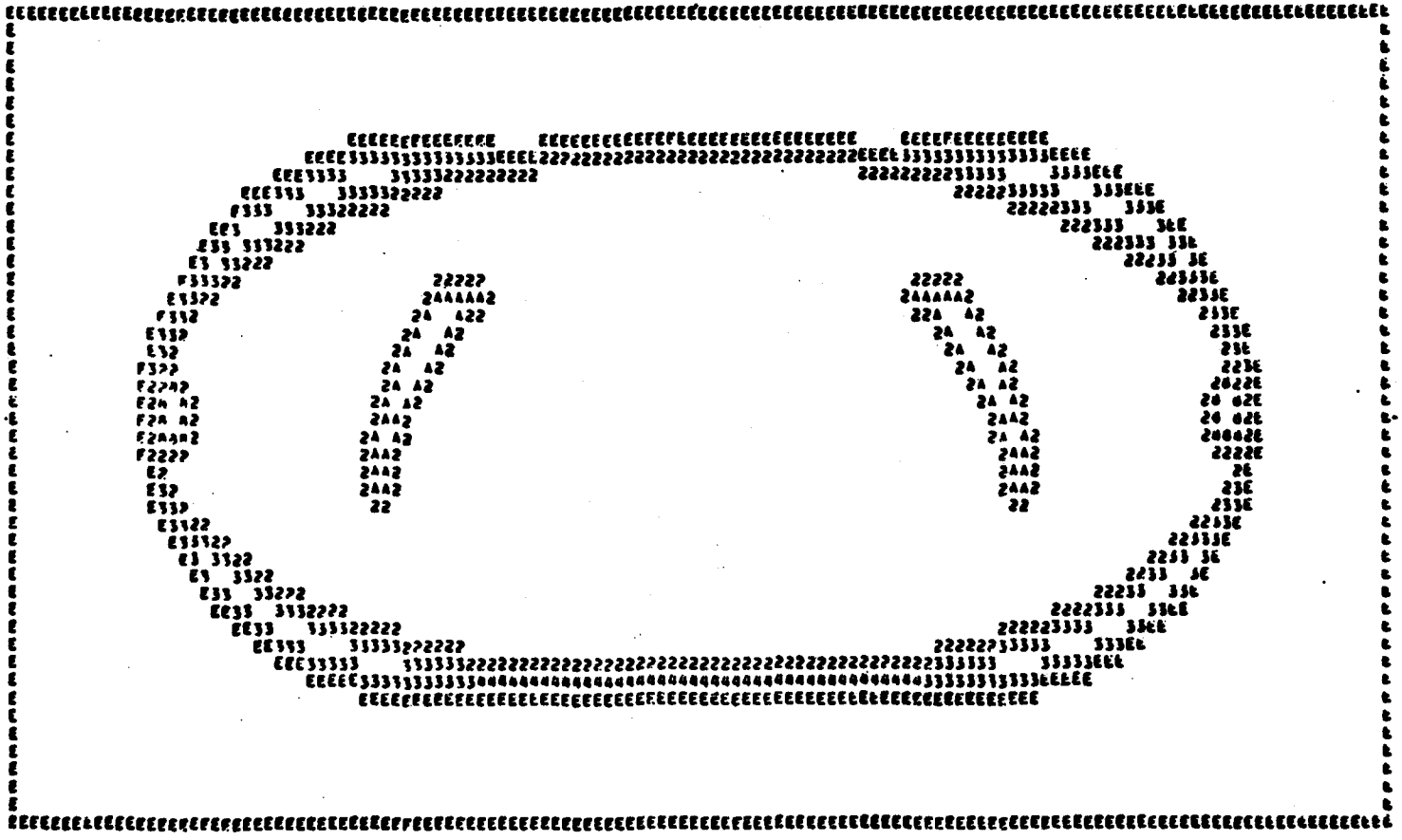


Figure II-5 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=0 (legs, trunk, arms, pelvis)

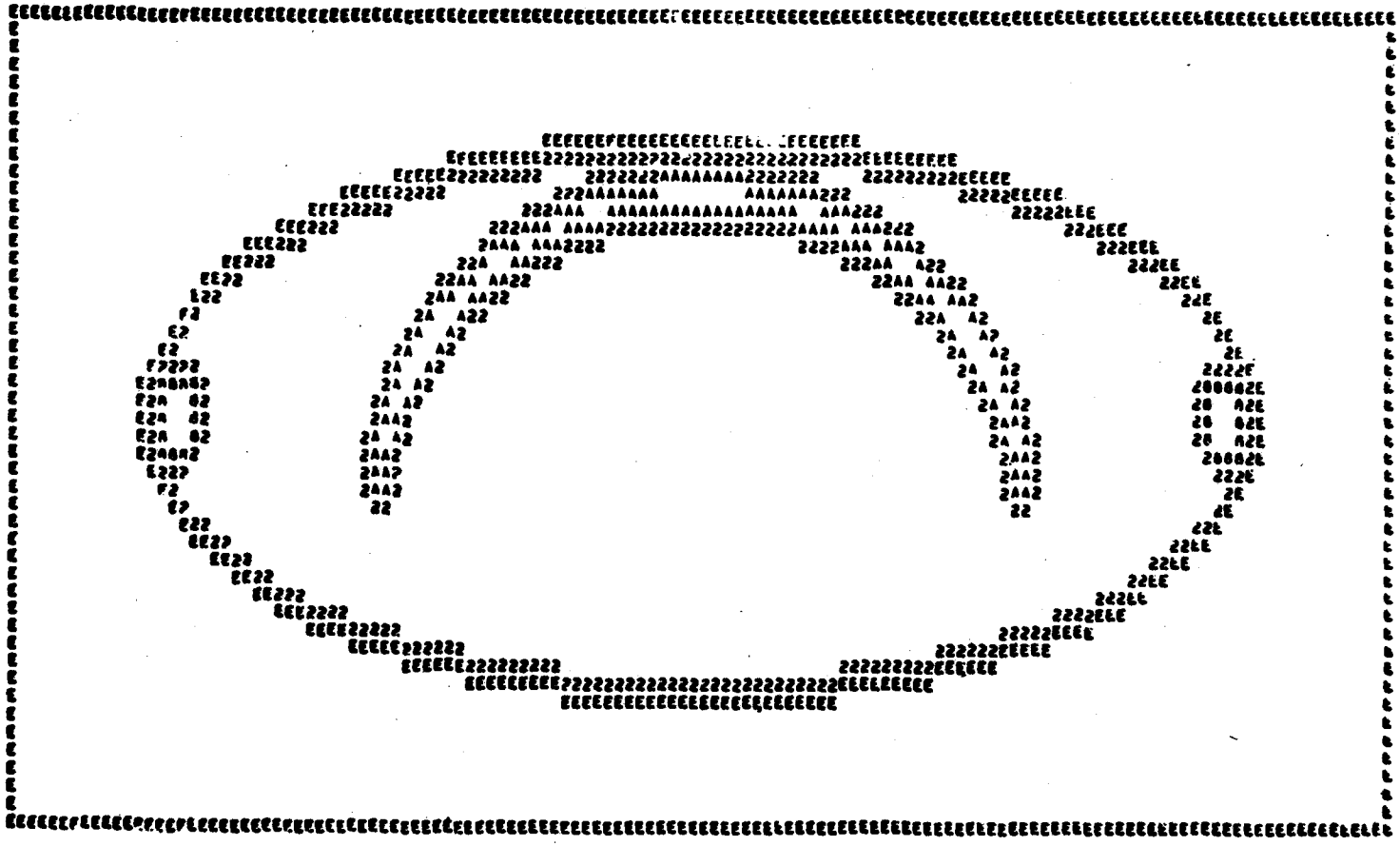


Figure II-6 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=20 (trunk, arms, pelvis)

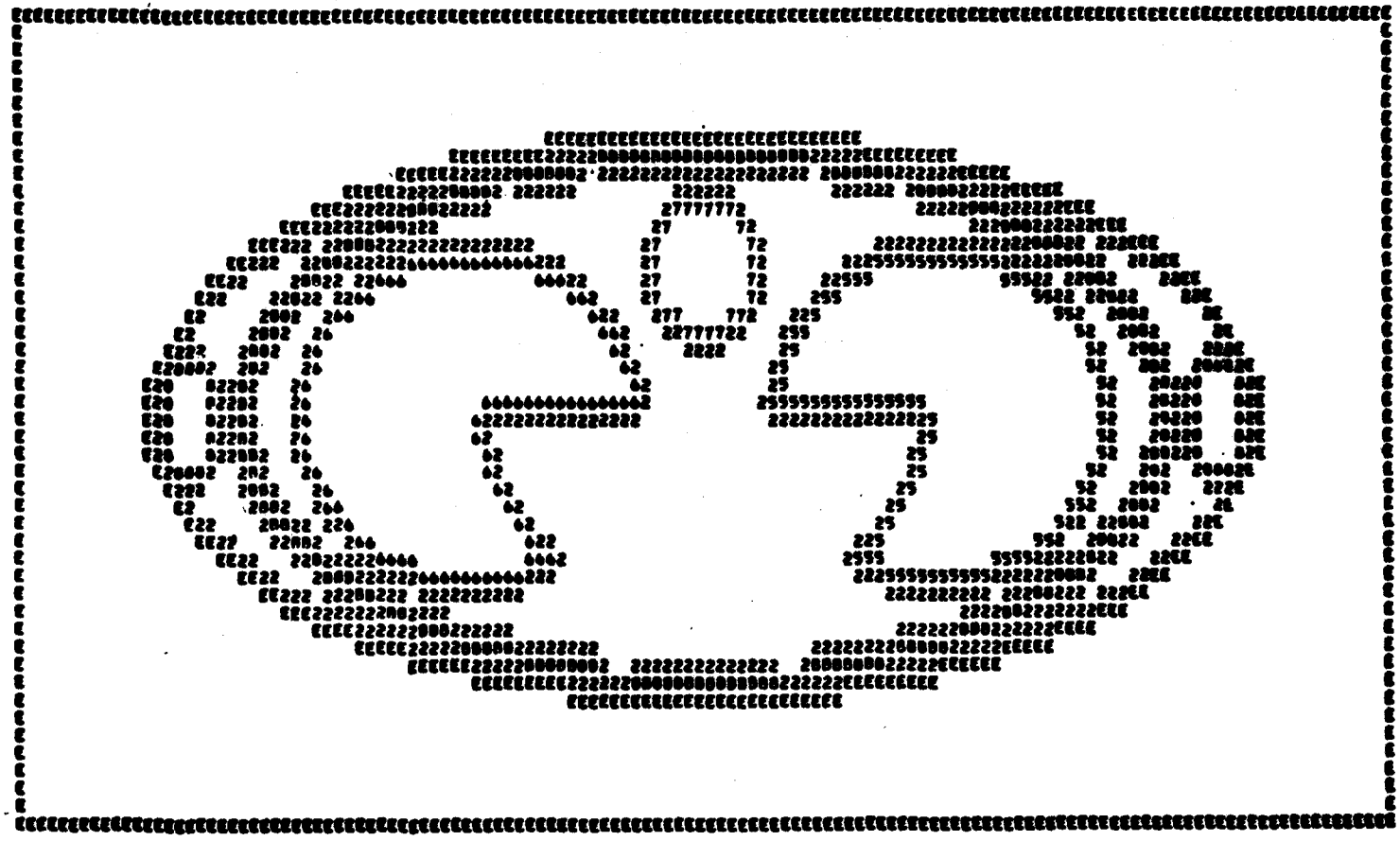


Figure II-7 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=44.0 (trunk, arm, rib, lung, spine)

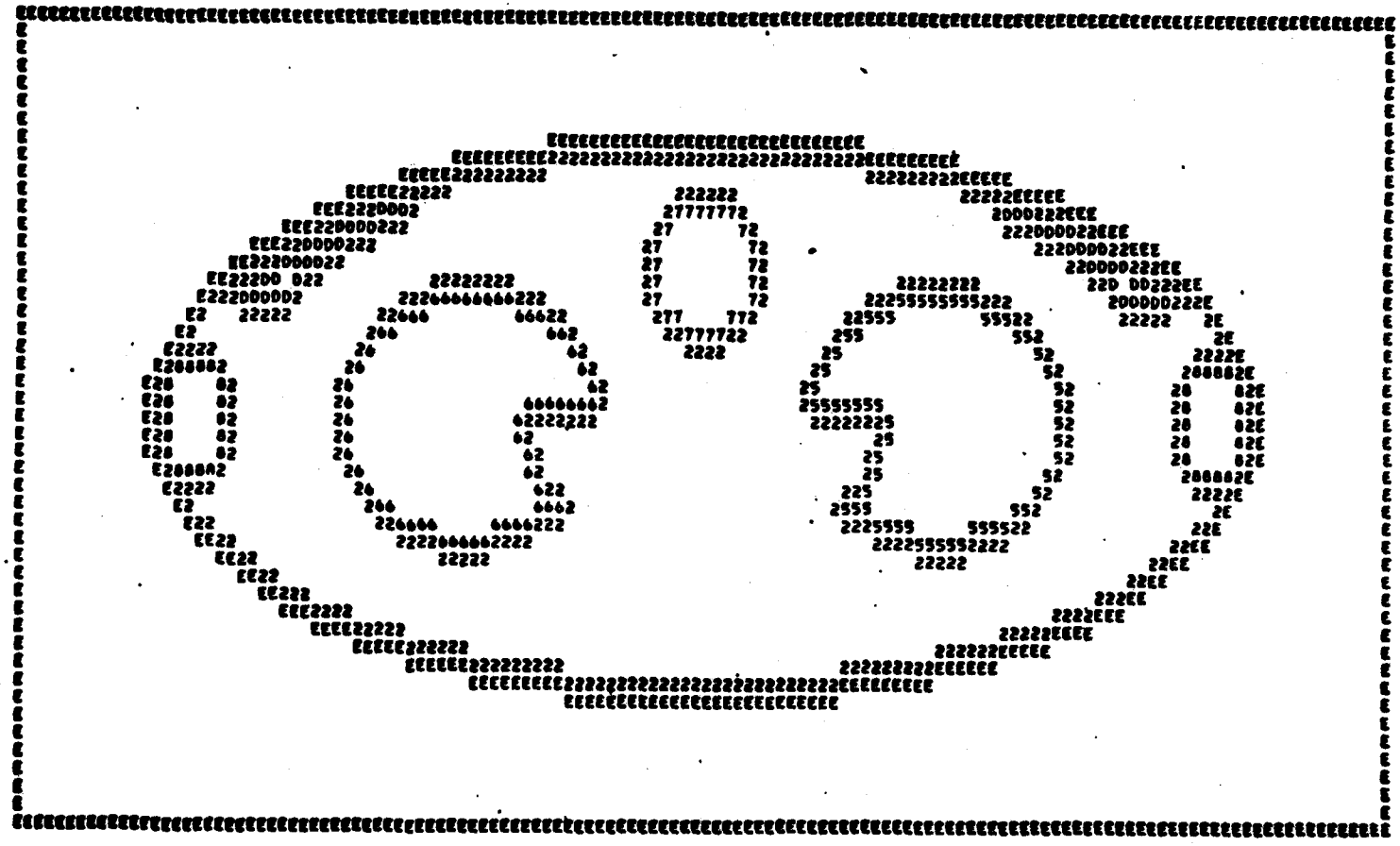


Figure II-8 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z= 59.1 (trunk, arm, scapula, lung, spine)

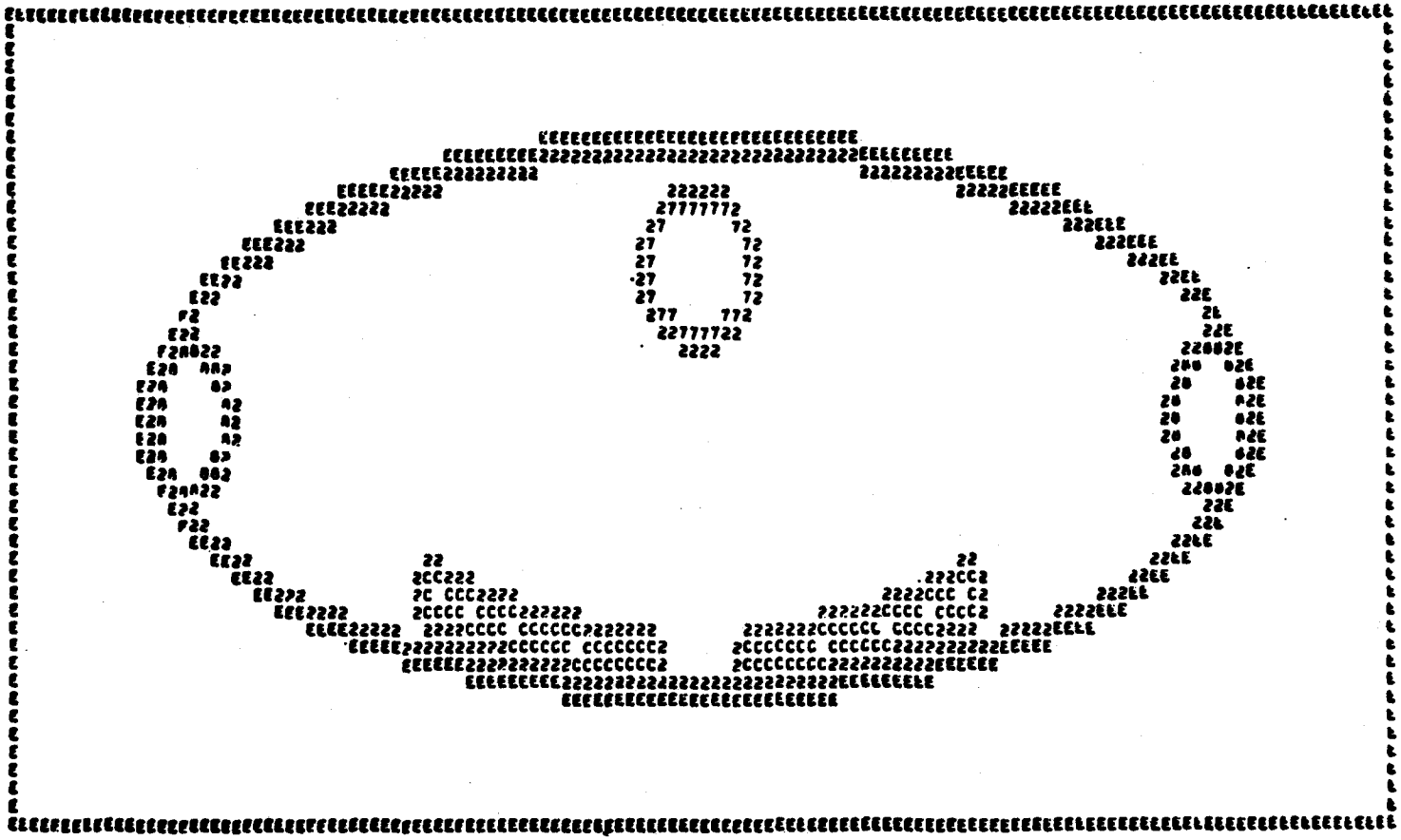


Figure II-9 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=68.25 (trunk, arm, clavicle, spine)

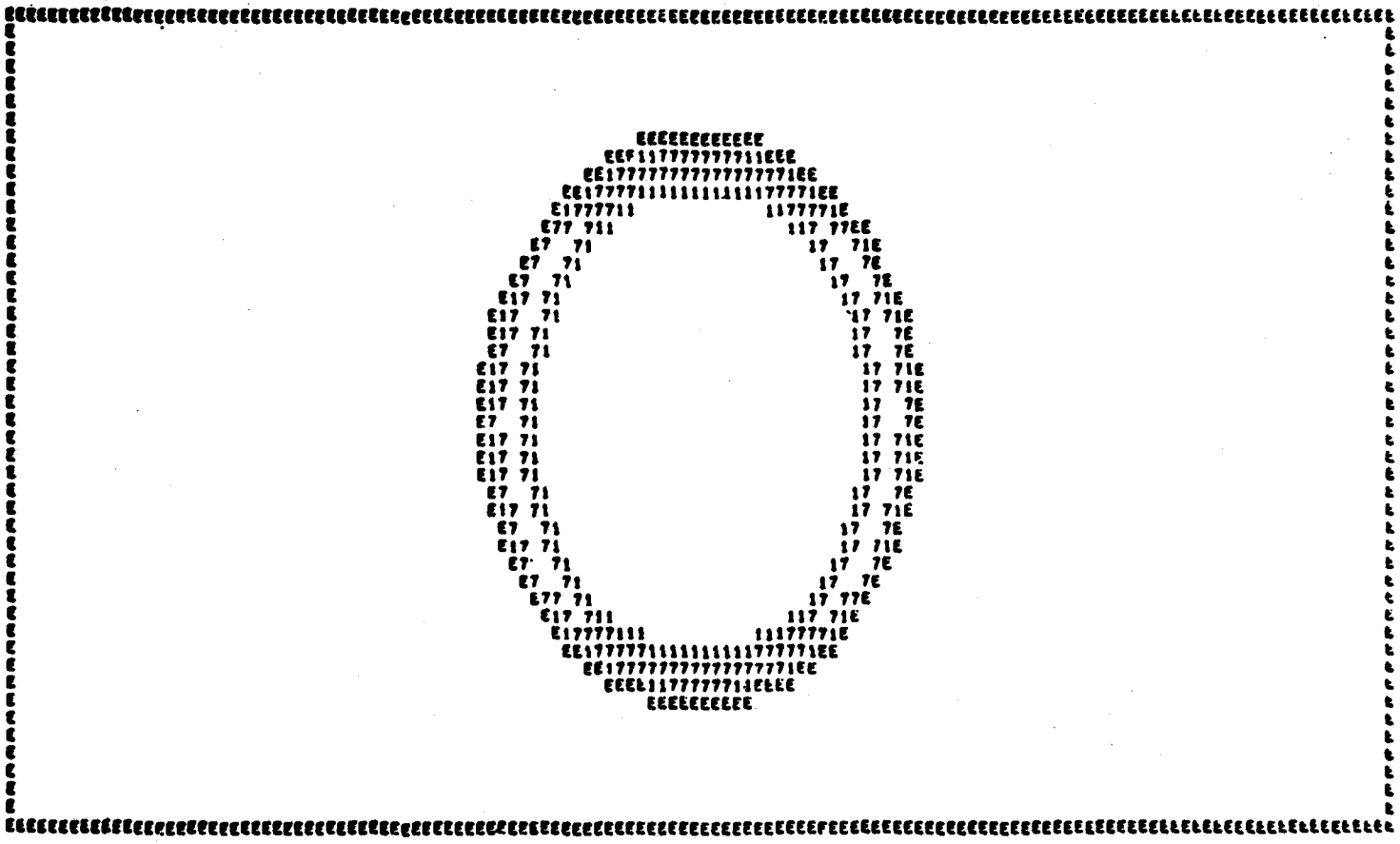


Figure II-10 Reference Man Phantom In Combinatorial Geometry
In the X-Y Plane at Z=85.5 (head and skull)

THE DOSIMETRY

The objective of the calculations was to determine dose to bone marrow. More particularly, this has been limited to the active bone marrow, i.e., that portion of the marrow which supports the maintenance of blood cell levels within the body. Thus, the dosimetric regions within the body are those containing active (red) marrow. These regions are shown in Figure II-11, along with the fraction of marrow in each region. Specific locations of these regions of active marrow within the skeleton are given in Appendix A. The marrow is assumed to be uniformly distributed within the skeleton in these regions.

The skeleton is made up of cortical (hard) and trabecular (spongy) bone, red and yellow marrow, cartilage and periarticular tissue. For the purpose of radiation transport in skeletal regions the precise locations of all these individual constituents are not taken into account. However, for the purpose of dosimetry consideration must be given to the size and location of active marrow and surrounding regions in order to insure that conditions of local charged particle equilibrium required for dose calculations from KERMA factors are in fact met.

Dose is deposited in the marrow by heavy charged particles, predominately protons, produced by neutron interactions and by electrons produced by photon interactions. The range of protons in water, which approximates the slowing-down properties of marrow, varies from 1.29 mm at 10 MeV to 0.0247 mm at 1 MeV and decreases rapidly below that energy (13). Ranges for heavier species such as alpha particles are even less, while those for electrons are considerably more, being on the order of a few millimeters for a 1 MeV electron (14). As described in ICRP 23, the active marrow is contained within interspaces between a network of plates and bars which comprise trabecular bone. For an adult, these spaces range in diameter

from 0.1 to 1.0 mm. The local charged particle equilibrium region and hence the dosimetric material for neutron interactions was selected as the active marrow alone (Table II-6). This choice was based on the above figures which indicate that the charged particles generated by neutrons at most energies of interest have ranges on the order of or considerably less than the characteristic dimension of the marrow. This is an important choice since homogenizing marrow and trabecular bone would have resulted in more than a 10% reduction in the hydrogen fraction for dosimetric purposes.

For photon interactions the local charged particle equilibrium region and hence the dosimetric material was selected to be the entire trabecular bone--active marrow mass (Table II-6). This selection was based on the range of energetic electrons in marrow and trabecular bone material, which is considerably greater than the characteristic marrow dimensions. This is important because the combined material contains 20 times the weight fraction of calcium as does marrow alone, and photoelectrons from calcium are the primary contributors to photon dose below a few hundred keV photon energy. On the other hand, the range of calcium photoelectrons is not so great as to require inclusion of the cortical bone in the dosimetric material, although this omission will result in an underestimate of the marrow dose from low energy photons within a millimeter or so of the trabecular-cortical bone interface.

KERMA values for equilibrium regions postulated as being applicable to charged particles produced by neutrons and gamma rays are given in Tables II-7 and II-8, respectively. Free-In-Air (FIA) tissue KERMA values provided with the DNA library are included in these tables for comparison.

Table II-6

ELEMENTAL COMPOSITION OF DOSIMETRIC REGIONS OF THE PHANTOM

Element	Red Marrow		Red Marrow & Trabecular Bone	
	Mass (g)[1][2]	Wt. %	Mass (g)[1][2]	Wt. %
C	618.0	41.2	686.6	34.3
H	159.0	10.6	180.1	9.06
N	48.0	3.2	66.7	3.36
O	672.6	44.8	897.4	45.1
P	1.64	0.11	46.0	2.31
S	0.05	0.00	1.3	0.065
Na	0.66	0.04	0.66	0.033
Mg	0.04	0.00	1.0	0.050
Ca	3.28	0.22	92.00	4.63
TOTAL	1503.27	100.17	1967.76	98.9
REFERENCE TOTAL	1500.00	100.0	1987.6	100.0

Reference ICRP 23, Report of the Task Group on Reference Man, Pergamon Press. (12)

(1) Tables 105 and 106.

(2) Table 108

Table II-7

Neutron KERMA (rad/unit fluence)

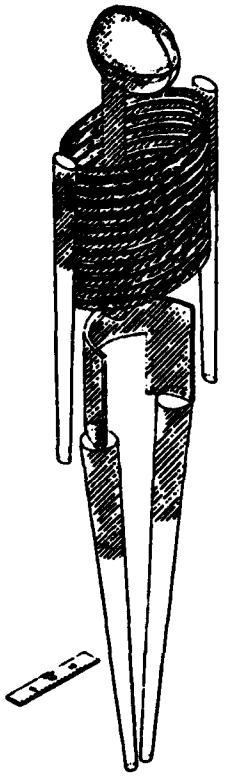
Group	Upper Energy Boundary (MeV)	Neutron red Marrow KERMA	Neutron Free-in-Air Tissue KERMA
1	19.6	7.185-09	7.00-09
2	16.9	6.842-09	6.64-09
3	14.9	6.625-09	6.43-09
4	14.2	6.522-09	6.33-09
5	13.8	6.406-09	6.19-09
6	12.8	6.247-09	6.00-09
7	12.2	6.139-09	5.93-09
8	11.1	5.915-09	5.68-09
9	10.0	5.848-09	5.53-09
10	9.0	5.454-09	5.22-09
11	8.2	5.439-09	5.12-09
12	7.4	5.053-09	4.86-09
13	6.4	4.801-09	4.56-09
14	5.0	4.555-09	4.32-09
15	4.7	4.504-09	4.26-09
16	4.1	4.316-09	4.04-09
17	3.0	3.687-09	3.43-09
18	2.4	3.379-09	3.14-09
19	2.3	3.272-09	3.07-09
20	1.8	2.805-09	2.65-09
21	1.1	2.128-09	2.01-09
22	5.5-01	1.321-09	1.25-09
23	1.6-01	8.175-10	7.68-10
24	1.1-01	5.694-10	5.35-10
25	5.2-02	3.208-10	3.02-10
26	2.5-02	2.182-10	2.05-10
27	2.2-02	1.500-10	1.41-10
28	1.0-02	6.384-11	6.01-11
29	3.4-03	2.252-11	2.12-11
30	1.2-03	9.403-12	8.88-12
31	5.8-04	3.215-12	3.07-12
32	1.0-04	1.183-12	1.14-12
33	2.9-05	1.178-12	1.12-12
34	1.1-05	1.795-12	1.69-12
35	3.1-06	3.038-12	2.82-12
36	1.1-06	4.979-12	4.60-12
37	4.1-07	2.048-11	1.88-11
	1.0-11		

Table II-8

Gamma Ray KERMA (rad/unit fluence)

Group	Upper Energy Boundary (MeV)	Gamma ray marrow-Trabecular bone KERMA	Gamma Free-in-Air Tissue KERMA
1	14.0	2.942-09	3.04-09
2	10.0	2.325-09	2.41-09
3	8.0	2.012-09	2.09-09
4	7.0	1.812-09	1.88-09
5	6.0	1.613-09	1.67-09
6	5.0	1.406-09	1.46-09
7	4.0	1.186-09	1.23-09
8	3.0	1.009-09	1.05-09
9	2.5	8.800-10	9.15-10
10	2.0	7.384-10	7.68-10
11	1.5	5.749-10	5.98-10
12	1.00	4.197-10	4.36-10
13	0.70	2.935-10	3.05-10
14	0.45	1.905-10	1.98-10
15	0.30	1.078-10	1.11-10
16	0.15	5.575-11	5.56-11
17	0.10	4.329-11	4.02-11
18	0.07	4.976-11	4.09-11
19	0.045	9.694-11	7.34-11
20	0.030	2.156-10	1.63-10
21	0.020	6.661-10	5.22-10
	0.010		

ORNL-DWG 70-4810R



SKULL	13.1%
VERTEBRAE	28.4%
RIBS + STERNUM	10.2%
SCAPULAE	4.8%
HEAD AND NECK OF BOTH ARMS	1.9%
BOTH CLAVICLES	1.6%
HEAD AND NECK OF BOTH LEGS	3.8%
PELVIS	36.2%

TOTAL AMOUNT OF RED BONE MARROW: 1500 g

RED BONE MARROW

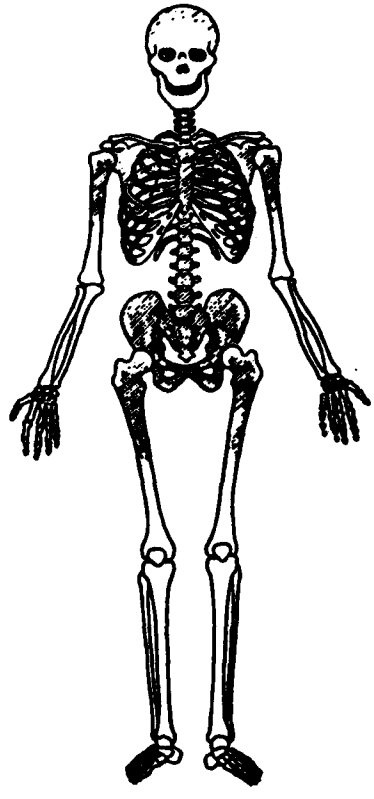


Fig. II-11 Idealized model of the skeleton for computer calculations (left) and a more realistic representation (right) with percentages of red bone marrow found in the shaded portions of the bones. Clavicles and scapulae not shown in phantom.

SECTION III
ACTIVE BONE MARROW DOSE DEPOSITION FACTOR (RESPONSE FUNCTION) CALCULATION

Calculations of adjoint marrow dose deposition factors, or response functions as they are sometimes called, were performed using the MORSE code, DNA Few Group Cross Section Library, reference man phantom and dosimetry specifications as described in the previous section. Transport was followed in the adjoint mode from the marrow locations to a spherical coupling surface of radius 200 cm about a point on the axis of the phantom at the base of the trunk of the body. Separate dose deposition calculations were performed for eight marrow regions as follows:

Region	Total Active Marrow Fraction
1. Pelvis	0.362
2. Vertebrae (spine)	0.284
3. Skull	0.131
4. Ribs and Sternum	0.102
5. Scapulae	0.048
6. Legs	0.038
7. Arms	0.019
8. Clavicles	0.016

In each case advantage was taken of the bilaterial symmetry of man, which allowed calculations to be performed for one side only and the results applied to components of both sides. To accomplish this, routines were written which uniformly distributed particle starting points over that portion of a given marrow component having positive X coordinates, i.e., that on the right side of the phantom.

Calculations were performed on a CDC7600 computer. Table III-1 presents some details of the Monte Carlo results. Separate calculations were performed for adjoint gamma ray and neutron transport so that the neutron-induced gamma ray portion of the dose could be isolated. Adjoint calculations of neutron starts had run times ranging from 94 seconds for the skull to 481 seconds for the spine. This range of run times indicates the sensitivity of the transport of neutrons of all energies to the amount of flesh surrounding the detector location, which is born out further by the number of scatterings recorded for transport from each region. The calculations in which only gamma rays were started have run times on the order of twice those for neutron starts. This is not due to the gamma transport but to that of the neutrons produced during the course of the calculation. In the adjoint sense the largest source of these neutrons in flesh material is gamma ray capture, particularly in hydrogen, the cross section for which is inversely proportional to neutron energy. Therefore, the adjoint gamma ray-induced neutrons have an initial energy spectrum heavily skewed to the lower energies. This results in the large number of scatters which require so much run time.

ANGLE-INTEGRATED RESULTS

Results of the active marrow dose deposition calculations were recorded in two forms. The first is a set of angle-integrated, energy-differential values applicable to the case of isotropic radiation fluence incidence on the coupling surface. These results are tabulated in detail for all eight marrow regions and for reference man in Appendix B of this report. Figures III-1 through III-10 present them in graphical form for reference man and for the four regions of the body (pelvis, spine, skull, ribs) which contain the highest fraction of active marrow, together possessing .879 of the total. Values for reference man were obtained by adding marrow fraction-weighted dose deposition factors for the eight red marrow

regions. For the purpose of gaining a qualitative understanding of the data presented in these figures, it should be noted that, of the four specific regions represented, two, the pelvis and spine, are deep within the body, while the other two, the skull and ribs, are shallow. Thus, the data graphically presented here for deep marrow regions may also be considered representative of those for the legs. Together, these deep marrow regions account for .684 of the total in the body. Likewise, results for the skull and ribs may be considered representative of the other shallow marrow in the body, which resides in the arms, scapulae and clavicles. Shallow marrow constitutes .316 of the total in the body.

Figures III-1 through III-5 contain angle-integrated gamma ray dose deposition ($\gamma - \gamma$) factors (rad (marrow) per unit gamma ray fluence) for 20 of the 21 gamma ray energy groups for which data were produced. Those data not included in the figures are for energies between 10 and 14 MeV and are consistent with values up to that energy. In comparison with tissue KERMA used to compute free-in-air dose (rad (tis)) the marrow dose deposition is lower by fairly consistent factors for both deep and shallow marrow, and hence for reference man, down to photon energies of a few hundred keV. Below that energy substantial differences occur between tissue KERMA and the marrow response and between the responses of deep and shallow marrow. These differences are caused by the attenuation of low energy photons in the body which more than counteracts the rise in KERMA due to the photoelectric effect. The result of this attenuation is less pronounced in the shallow marrow than in the deep marrow, which dominates the response for reference man.

The fractional standard deviation (FSD) of the calculated γ-γ deposition results is summarized on the following page.

γ-γ Dose Deposition FSD

Gamma Ray Energy (MeV)	Shallow Marrow	Deep Marrow
14.0 to 0.7	< .05	< .050
0.7 to 0.03	< .05	< .075
0.03 to 0.02	< .10	> .20
0.02 to 0.01	< .50	No Data

The lack of data for dose deposition in the deep marrow for the lowest energy photons indicates all such photons followed from that marrow in the adjoint mode upscattered before exiting the phantom. Conversely it should follow that such photons incident on the phantom are virtually incapable of penetrating to the deep marrow.

Figures III-6 through III-10 present the angle-integrated partial dose deposition factors for active marrow for incident neutrons in 37 energy groups. These data are coplotted with neutron tissue KERMA free-in-air. The portion of the active marrow dose deposited by incident neutrons as depicted in these figures is limited to that resulting from energy deposition by neutron-induced heavy charged particles and is hereafter referred to as the n-n dose component. The FSD values of the calculated n-n deposition results are summarized below:

n-n Dose Deposition FSD

Neutron Energy (MeV)	Shallow Marrow
19.6 to 4.97	< .05
4.97 to 0.111	< .10
0.111 to 3.35-3	< .20
3.35-3 to 4.14-7	> .20
Thermal	< .10
	Deep Marrow
19.6 to 7.41	< .05
7.41 to 2.31	< .10
2.31 to 0.55	< .15
0.55 to 4.14-7	> .20
Thermal	< .20

As can be seen from these FSD values and from the apparent fluctuation in n-n deposition factors depicted in the figures, the statistical variation in these values for deep marrow below about .1MeV and for shallow marrow below .001MeV is very large for the individual marrow components. This is particularly true of the deep marrow. Fortunately, the dose contribution in this energy range from transported weapon neutrons is relatively small. Thus, in spite of the large statistical variance in the low energy data the total dose from such neutrons is usually statistically reliable to within 14% or better, as discussed in the summary section of this report. Also fortunately, the reference man weighted-average n-n response as depicted in Figure III-6 shows a reasonable degree of consistency over this low energy region. As such, it is used as the basis for the succeeding discussion of the n-n dose deposition component.

The n-n deposition is strongly dependent on incident neutron energy above approximately several keV. Between 20 MeV and a few 10's of keV the value for this dose component drops two orders of magnitude. Relative to the value of Tissue KERMA over the same energy range, the drop is from about .7 rad (marrow) per rad (tis,FIA) to about .1. Below this energy range the marrow dose deposition of incident neutrons continues to decrease, but less rapidly than does the tissue KERMA function. This results in equality between the two in the vicinity of a few keV. At energies below this, the n-n deposition is nearly constant with energy, while the tissue KERMA drops another order of magnitude before being enhanced at energies near thermal by the contribution of the (n,p) reaction in nitrogen. It is the contribution of this reaction in marrow which causes the constancy of the n-n deposition component below a few keV. Incident neutrons in this energy range deposit what little energy they possess by proton recoil, then distribute themselves such that a fraction are captured in the marrow, thereby contributing 626 keV per reaction to the deposited dose. This fraction apparently changes little until

the incident neutron possess energies at or near thermal, at which they can no longer penetrate sufficient distances in the body to reach the bulk of the marrow.

Figures III-11 through III-15 present the total dose deposition for incident neutrons and that component due exclusively to neutron-induced gamma rays produced within the body in comparison with neutron tissue KERMA used to compute free-in-air tissue dose (rad (tis)). The difference between the total dose deposition and neutron-induced gamma deposition is that which is due exclusively to neutrons. It can be seen from these figures that the neutron-induced gamma ray component (referred to hereafter as n-γ deposition) forms a floor upon which rests the remainder of the neutron marrow dose deposition energy dependence. Unlike the neutron tissue KERMA shown for comparison, this floor has virtually no dependence on neutron energy. In fact, the n-γ component is so uniform over the entire neutron energy range that the resulting dose may be considered to depend on neutron number fluence only. For deep marrow, which constitutes the majority of that in reference man, this fluence-dose conversion is approximately 1.6×10^{-10} rad (marrow) per unit neutron fluence, while for shallow marrow the dose deposition is approximately 85% of this value. Exceptions to this occur at neutron energies greater than about 6 MeV and those about thermal. The former exception can be explained by the additional contribution above this energy of substantial amounts of inelastic scatter gamma ray production. The reason for the latter is a bit more difficult to pinpoint. However, it is probably due to geometry considerations. Very low energy neutrons are not able to penetrate into the body past more than the very shallowest marrow. Therefore, about half the photons produced by these neutrons will exit the body without having to pass through any but a small amount of marrow. Thus, as might be expected, the n-γ dose deposition for thermal neutrons incident on reference man is about half that for more energetic neutrons.

The fractional standard deiviation (FSD) of the calculated n-γ deposition results is summarized below:

n-γ Dose Deposition FSD

Neutron Energy (MeV)	Shallow Marrow	Deep Marrow
19.6 to 8.99	< .12	< .10
8.19 to 5.25-2	< .20	< .15
5.25-2 to 2.90-5	< .20	< .20
2.90-5 to 4.14-7	< .30	< .35
Thermal	$\sim$ .11	$\sim$ .11

The poorer shallow marrow FSD figures for high energy neutrons result from increased neutron leakage at lower neutron energies and the increased leakage of high energy photons from which adjoint neutrons of high energy might originate directly.

As previously noted, the total dose deposited by incident neutrons consists of the sum of the n-n and n-γ components. The statistical variation of this total is a composite of those for the two components. FSD values for the n-n component dominate this composite for neutron energies above a few hundred keV, while those for the n-γ component dominate below this energy range. The result is that for typical transported weapon neutron spectra the predicted statistical variance of the calculated total marrow dose deposited by incident neutrons is 16% or better.

Table III-1

Monte Carlo Details of Active Marrow Dose Calculation

Calculation	Histories	Run Time (sec)	Scatterings	Secondaries Generated
γ and n-γ				
Pelvis	16,000	846	175,861	23,096
Spine	16,000	978	170,159	22,416
Skull	16,000	202	68,762	13,470
Ribs & Sternum	16,000	778	111,048	15,850
Scapulae	16,000	619	87,479	14,658
Legs	16,000	283	146,512	22,337
Arms	16,000	441	60,805	13,946
Clavicles	16,000	570	88,238	14,783
n-n				
Pelvis	16,000	388	76,491	None
Spine	16,000	442	72,327	
Skull	16,000	105	37,158	
Ribs & Sternum	16,000	404	45,806	
Scapulae	16,000	344	42,252	
Legs	16,000	124	71,334	
Arms	16,000	271	38,165	
Clavicles	16,000	325	42,140	

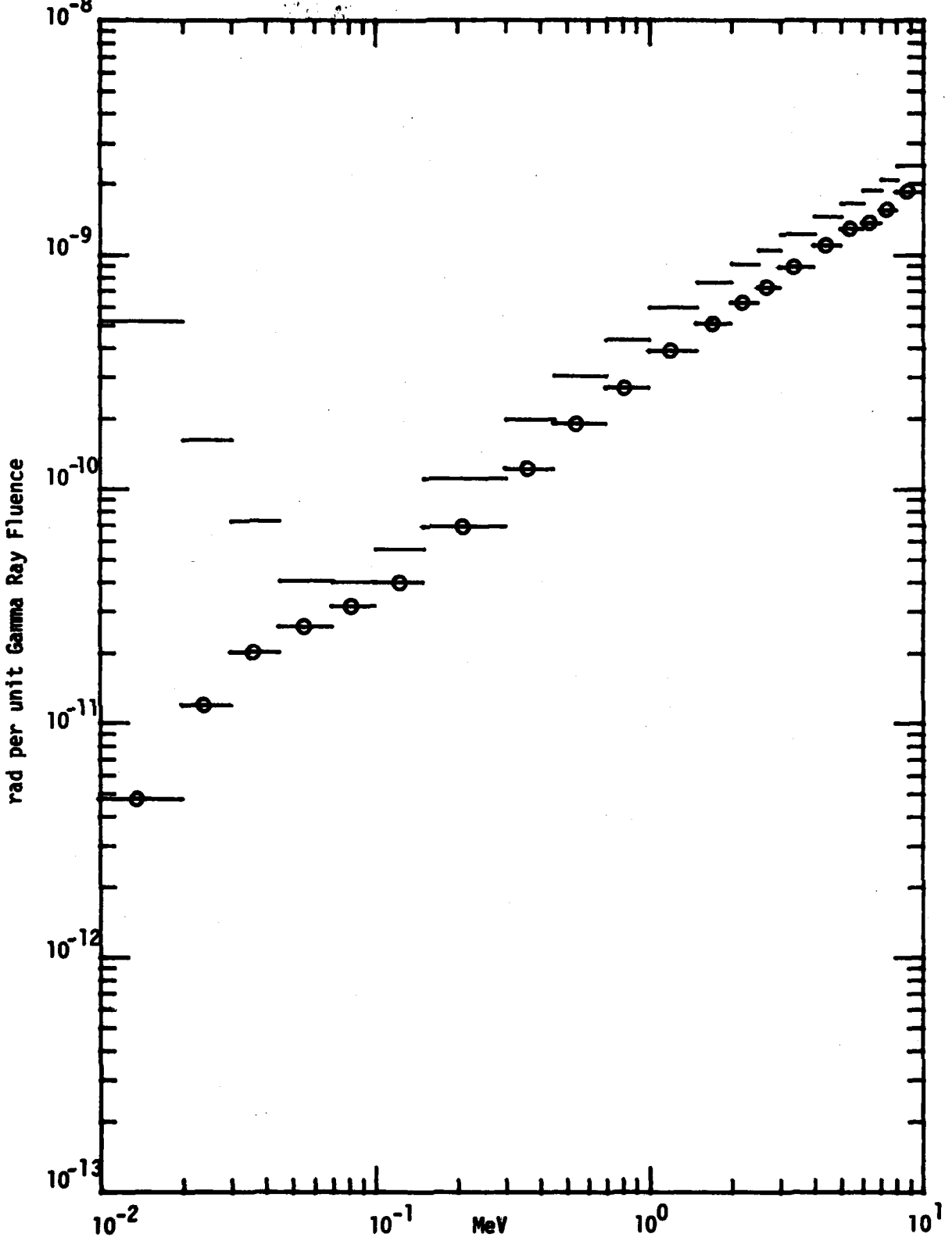


Figure III-1 Dose Deposition Per Unit Gamma Ray Fluence
Tissue Kerma Free-in-Air (———) rad (tis)
Reference Man Active Marrow (—⊖—) rad (red marrow-trabecular bone)

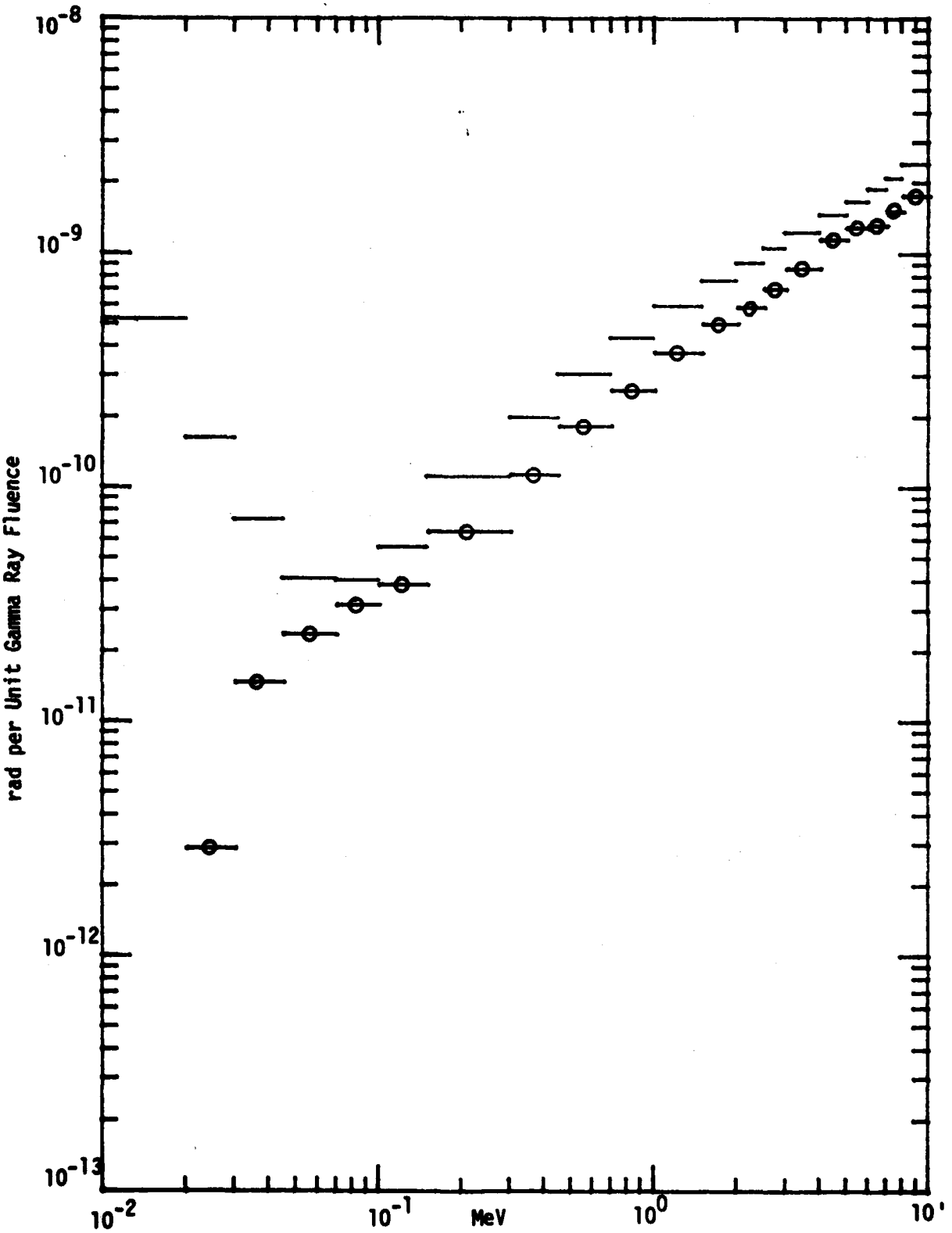


Figure III-2 Dose Deposition Per Unit Gamma Ray Fluence
Tissue Kerma Free-in-Air (———) rad (tis)
Pelvis Active Marrow (—⊖—) rad (red marrow-trabecular bone)

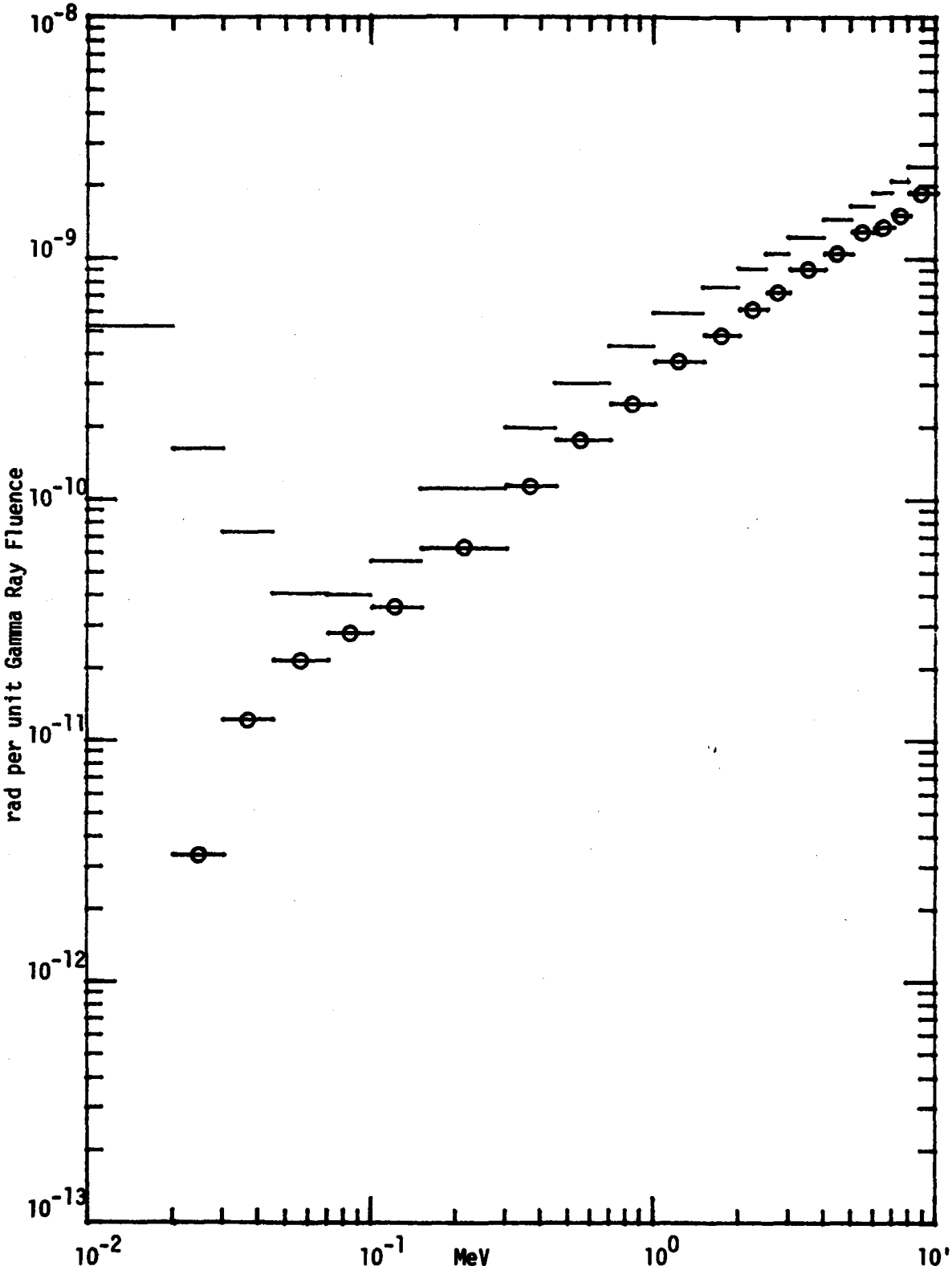


Figure III-3 Dose Deposition Per Unit Gamma Ray Fluence
Tissue Kerma Free-in-Air (———) rad (tis)
Spine Active Marrow (—⊖—) rad (rad marrow-trabecular bone)

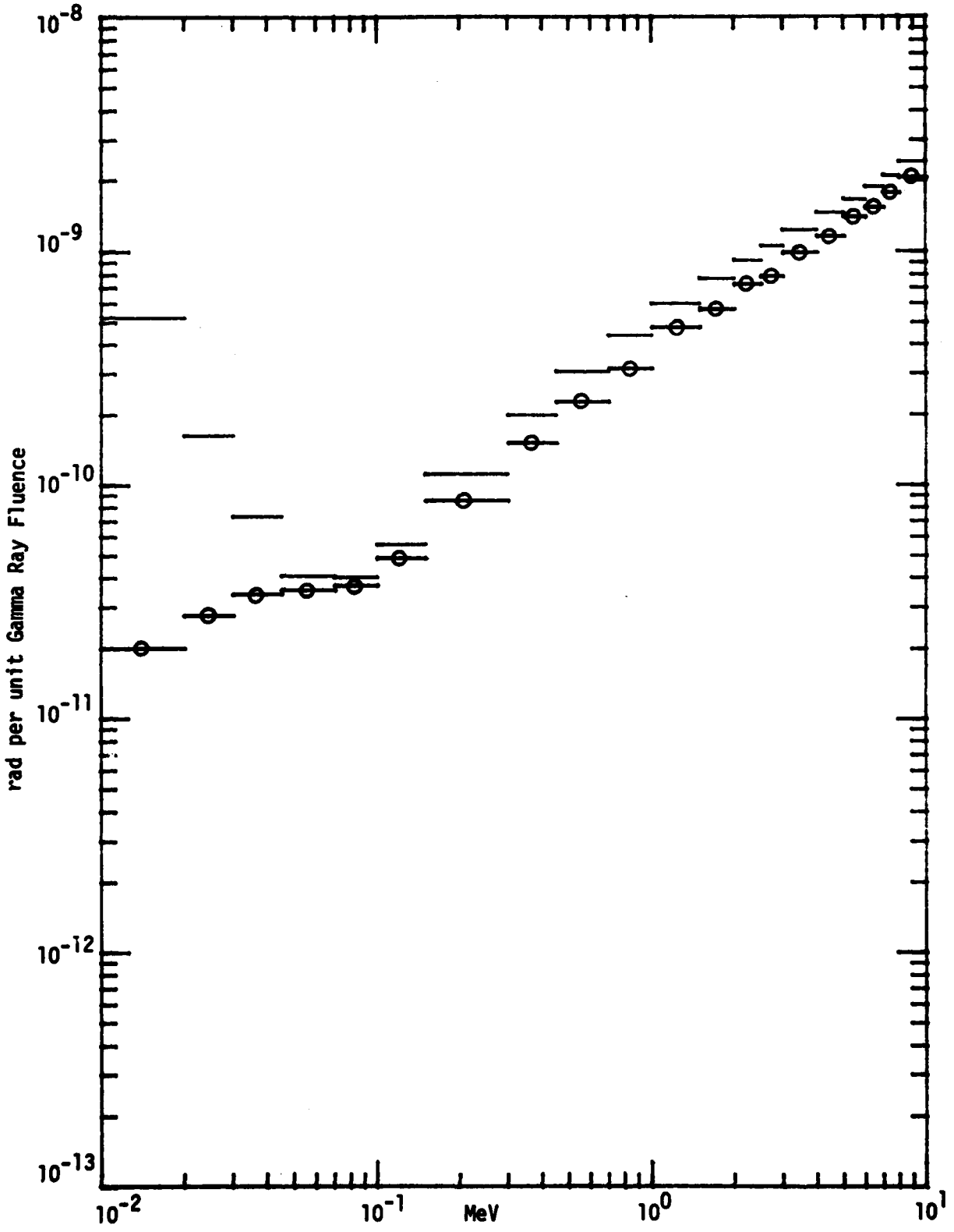


Figure III-4 Dose Deposition Per Unit Gamma Ray Fluence
Tissue Kerma Free-in-Air (———) rad (tis)
Skull Active Marrow (—⊖—) (red marrow-trabecular bone)

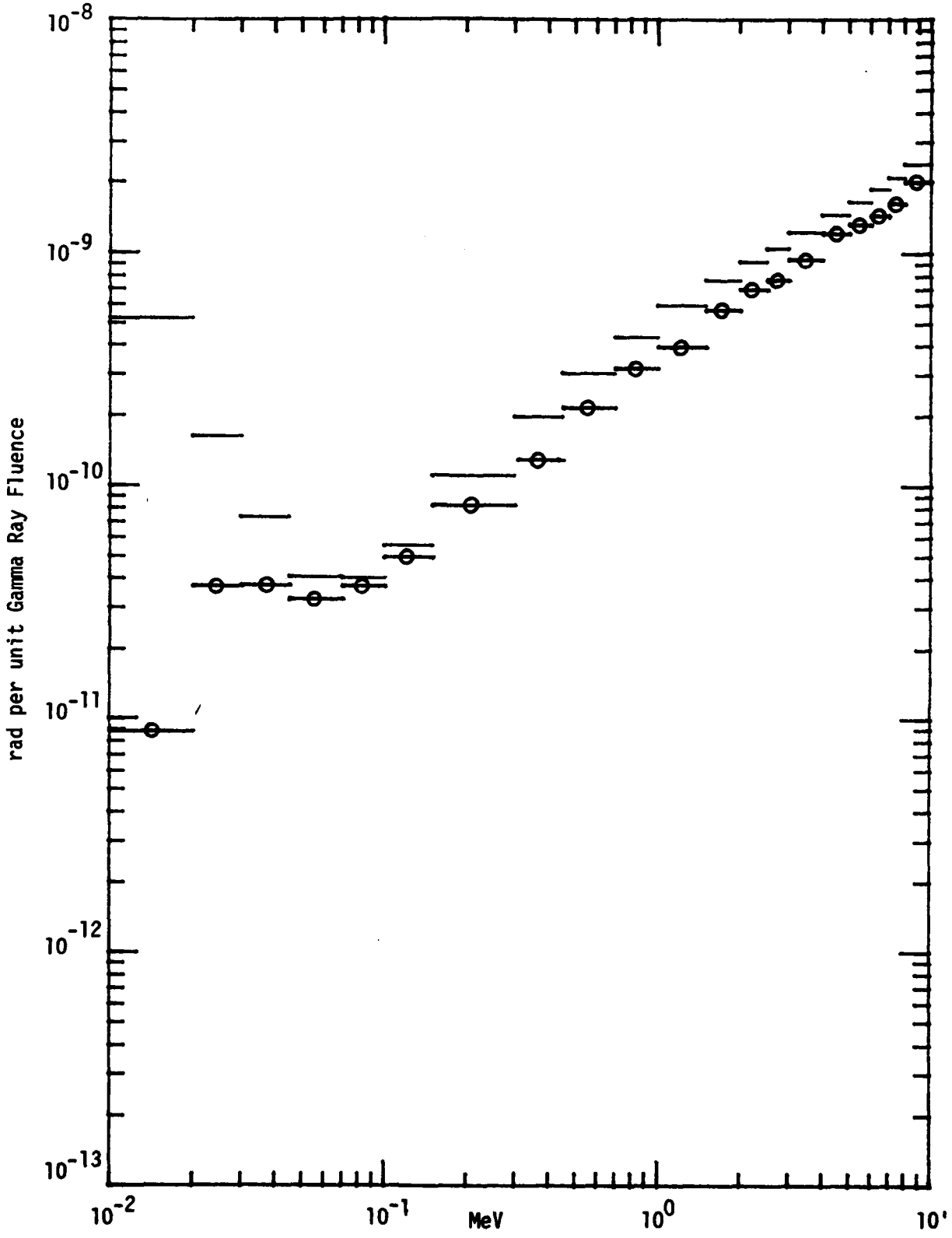


Figure III-5 Dose Deposition Per Unit Gamma Ray Fluence
Tissue Kerma Free-in-Air (———) rad (tis)
Rib Active Marrow (—O—) (red marrow-trabecular bone)

Figure III-6 Dose Deposition per unit neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Reference Man Active Marrow, n-n (—⊖—) rad (red marrow)

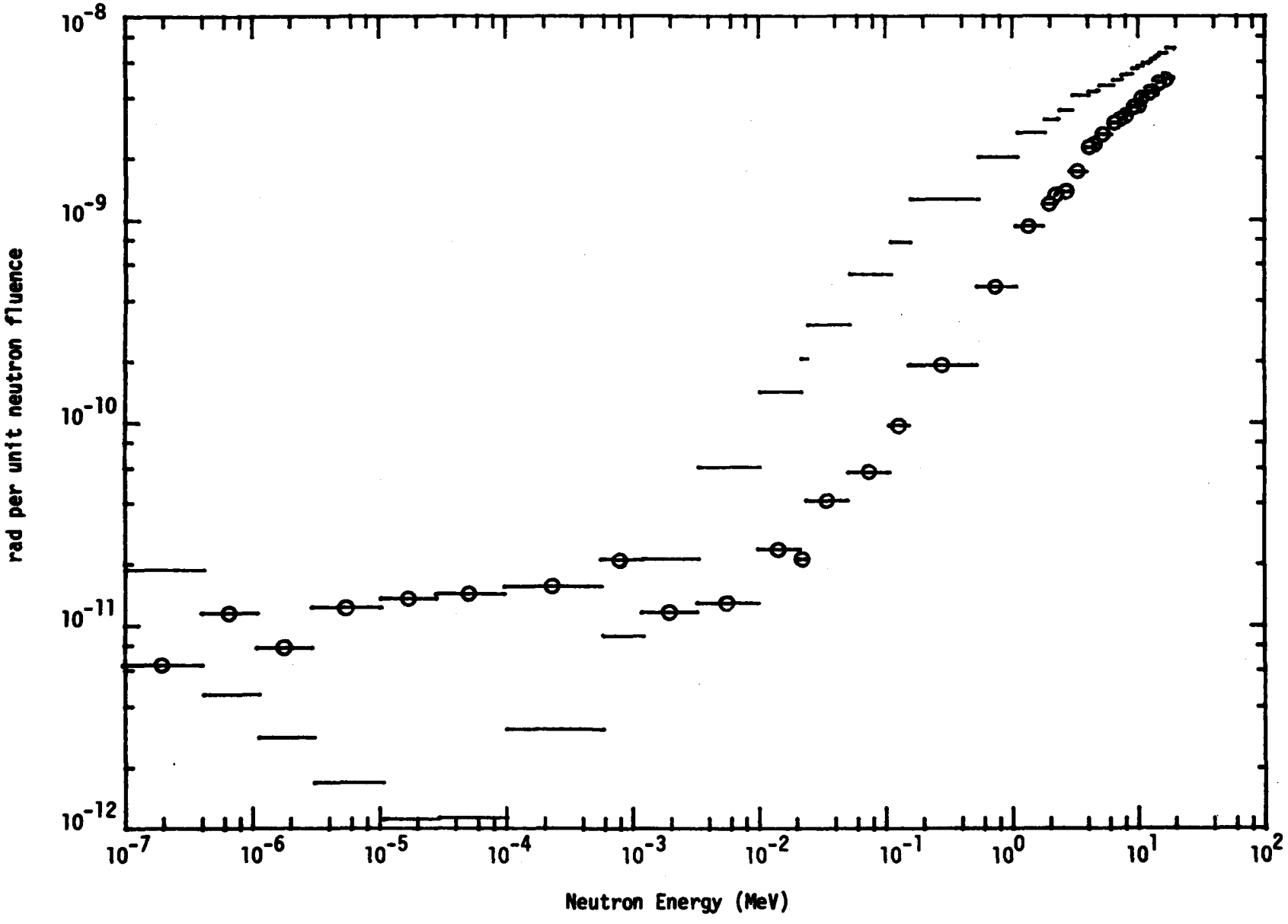


Figure III-7 Dose Deposition per Unit Neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Pelvis Active Marrow, n-n (—⊖—) rad (red marrow)

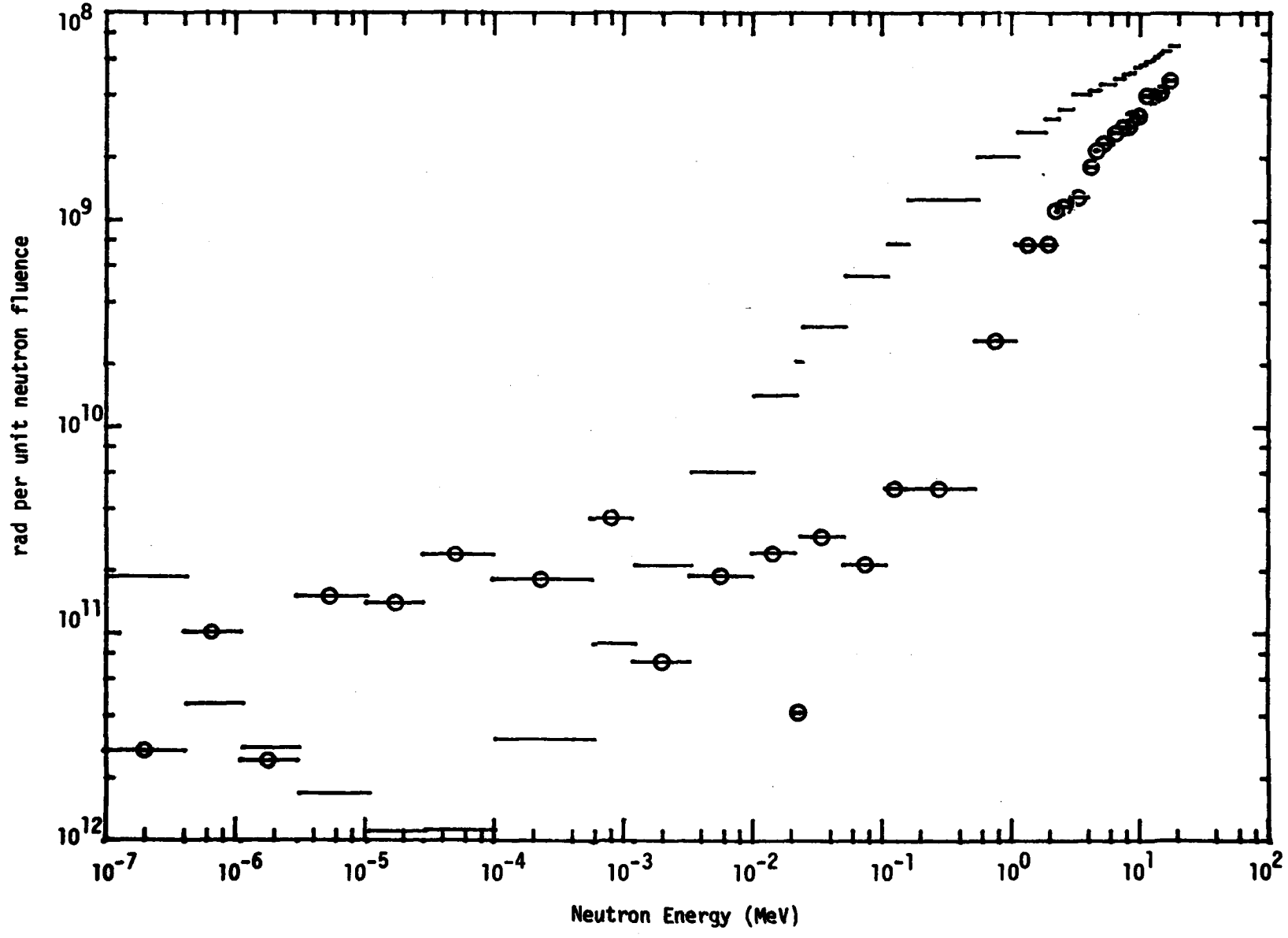


Figure III-8 Dose Deposition per Unit Neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Spine Active Marrow, n-n (—o—) rad (red marrow)

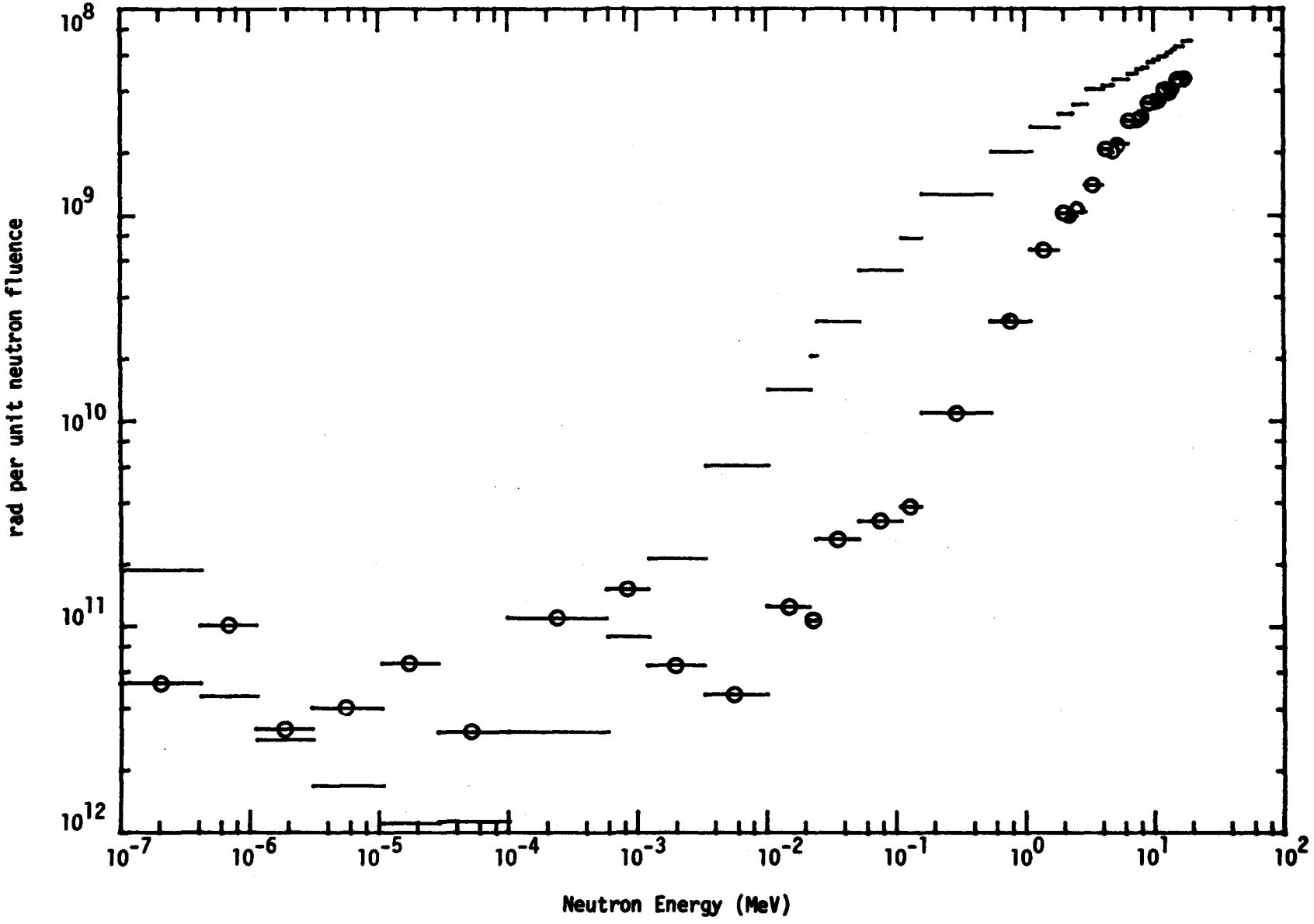
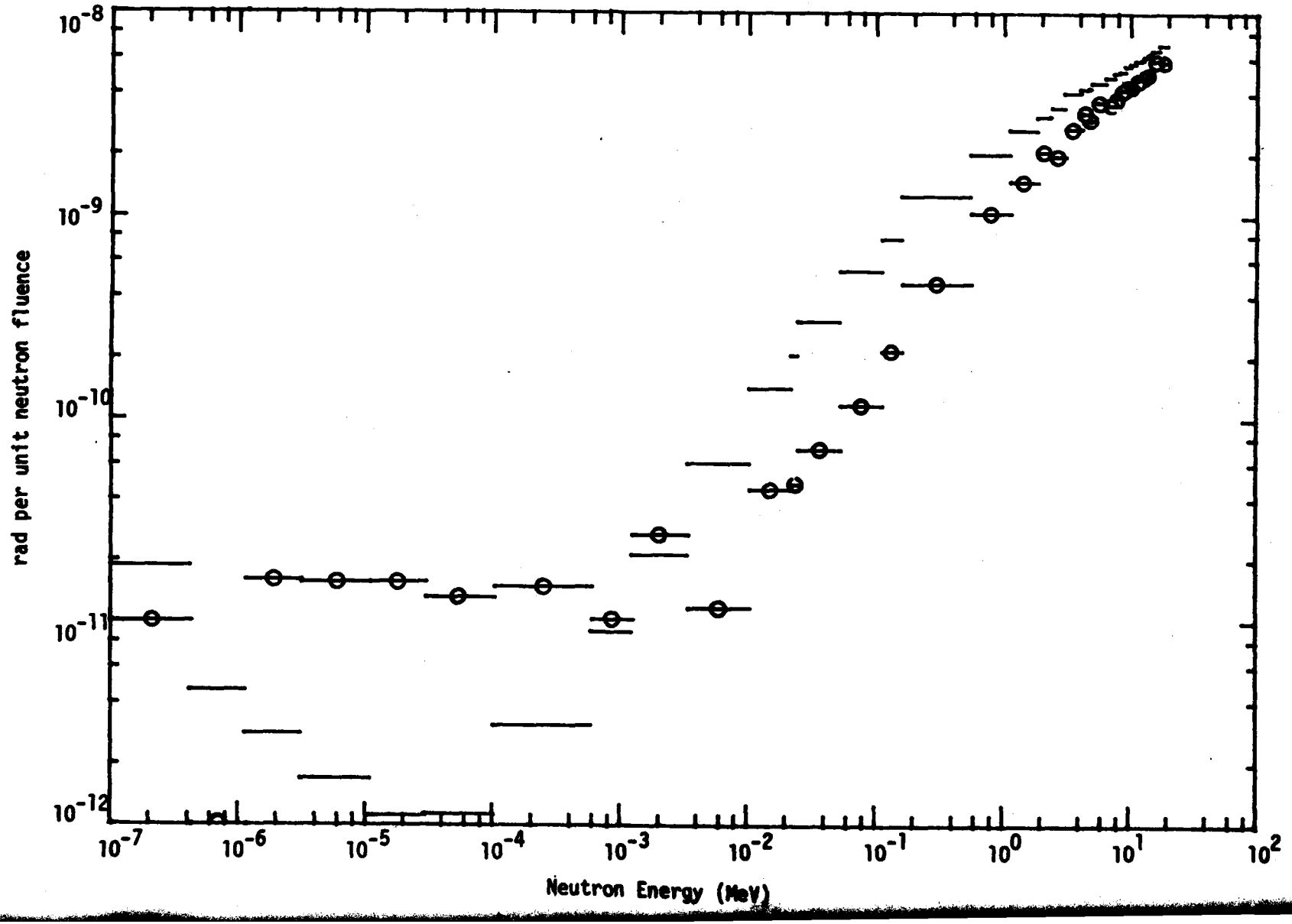


Figure III-9 Dose Deposition per unit neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Skull Active Marrow, n-n (—o—) rad (red marrow)



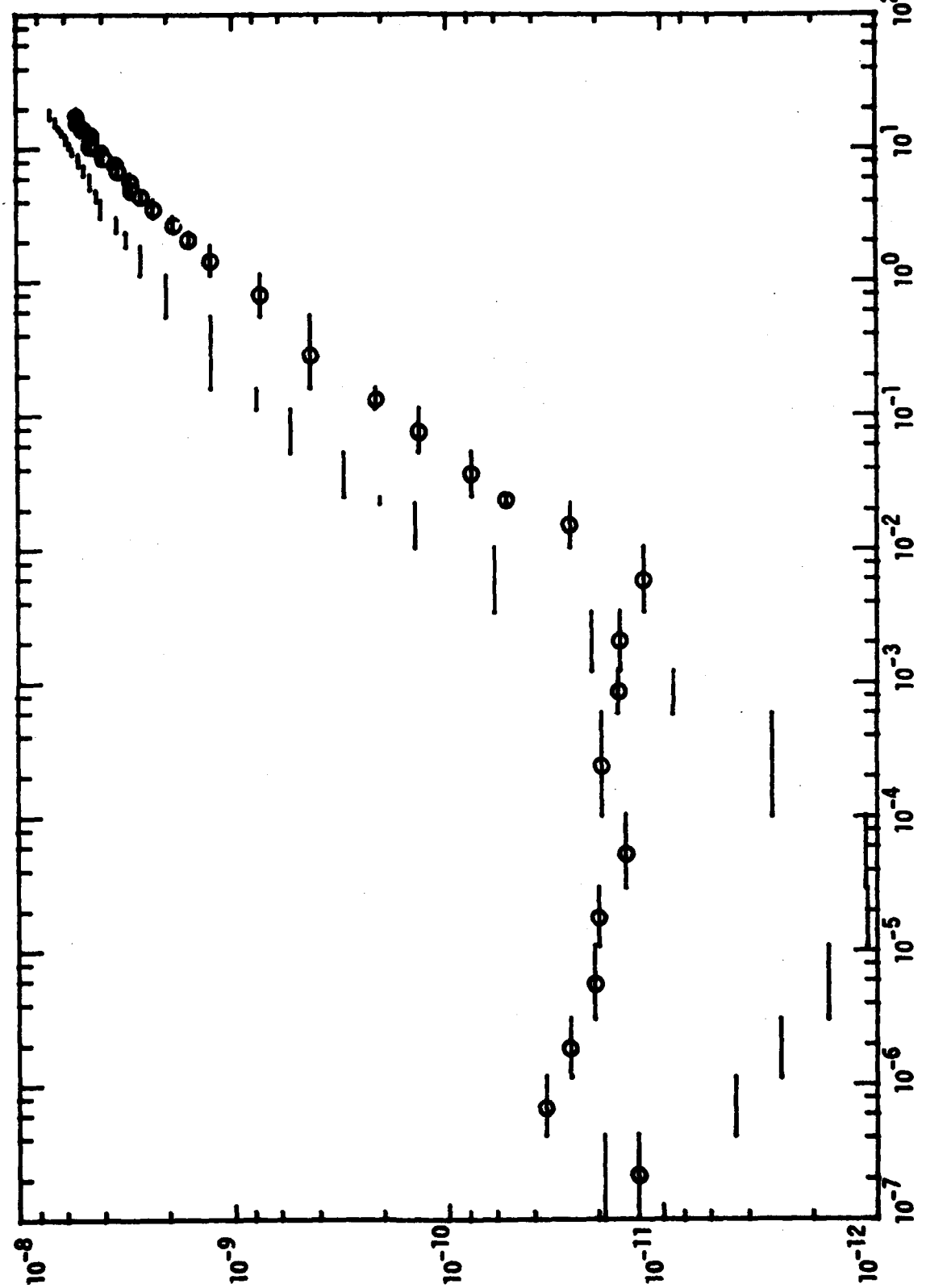


Figure III-10 Dose Deposition per Unit Fluence
Tissue Kerma free-in-air (———) rad (tis)
Rib Active Marrow, n-n (—⊖—) rad (red marrow)

Figure III-11 Dose Deposition per unit neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Reference Man Active Marrow, Total (—o—) rad (red marrow)
N-γ (—Δ—) rad (red marrow)

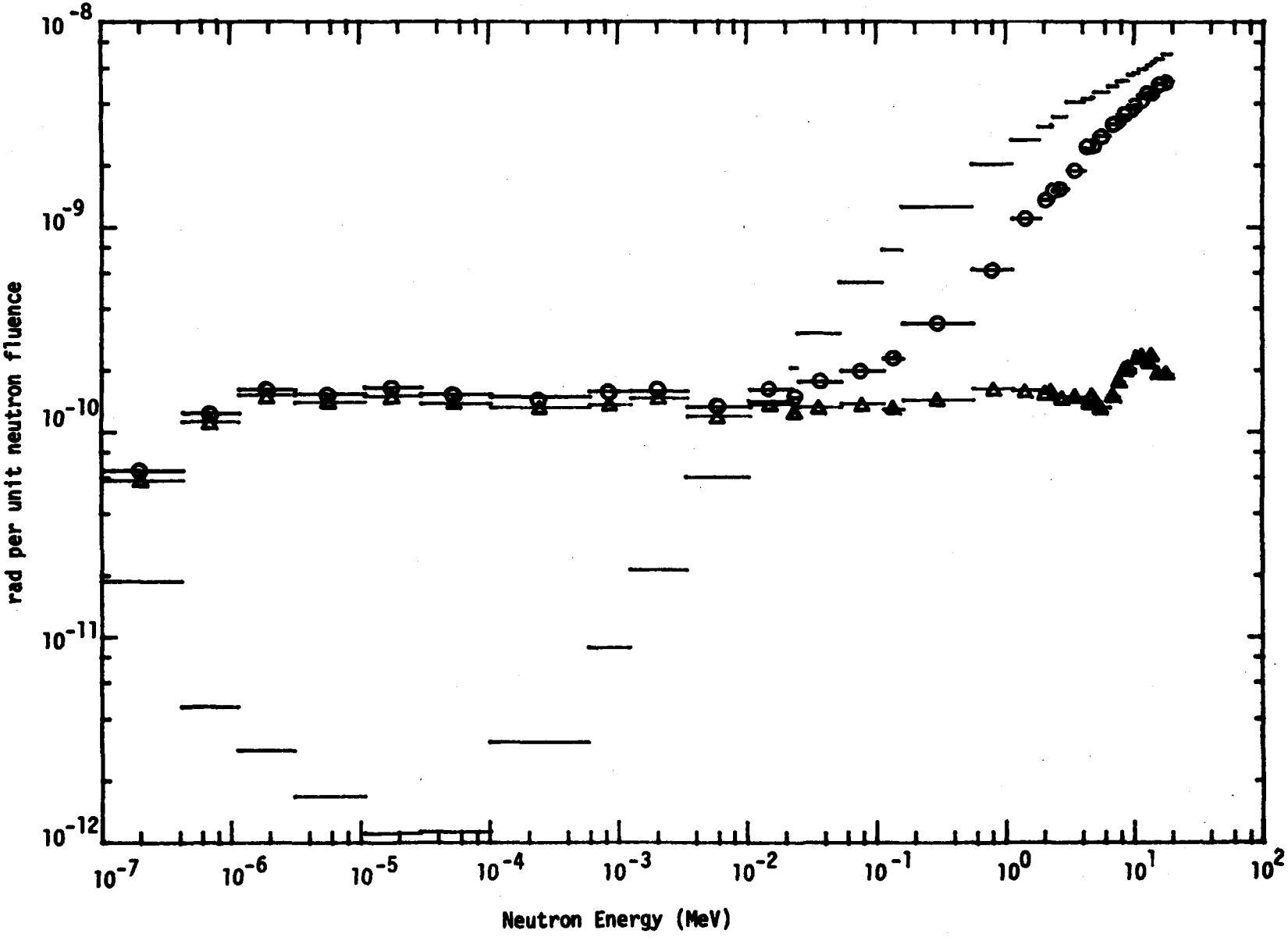


Figure III-12 Dose Deposition per Unit Neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Pelvis Active Marrow, Total (—o—) rad (red marrow)
N-γ (—Δ—) rad (red marrow)

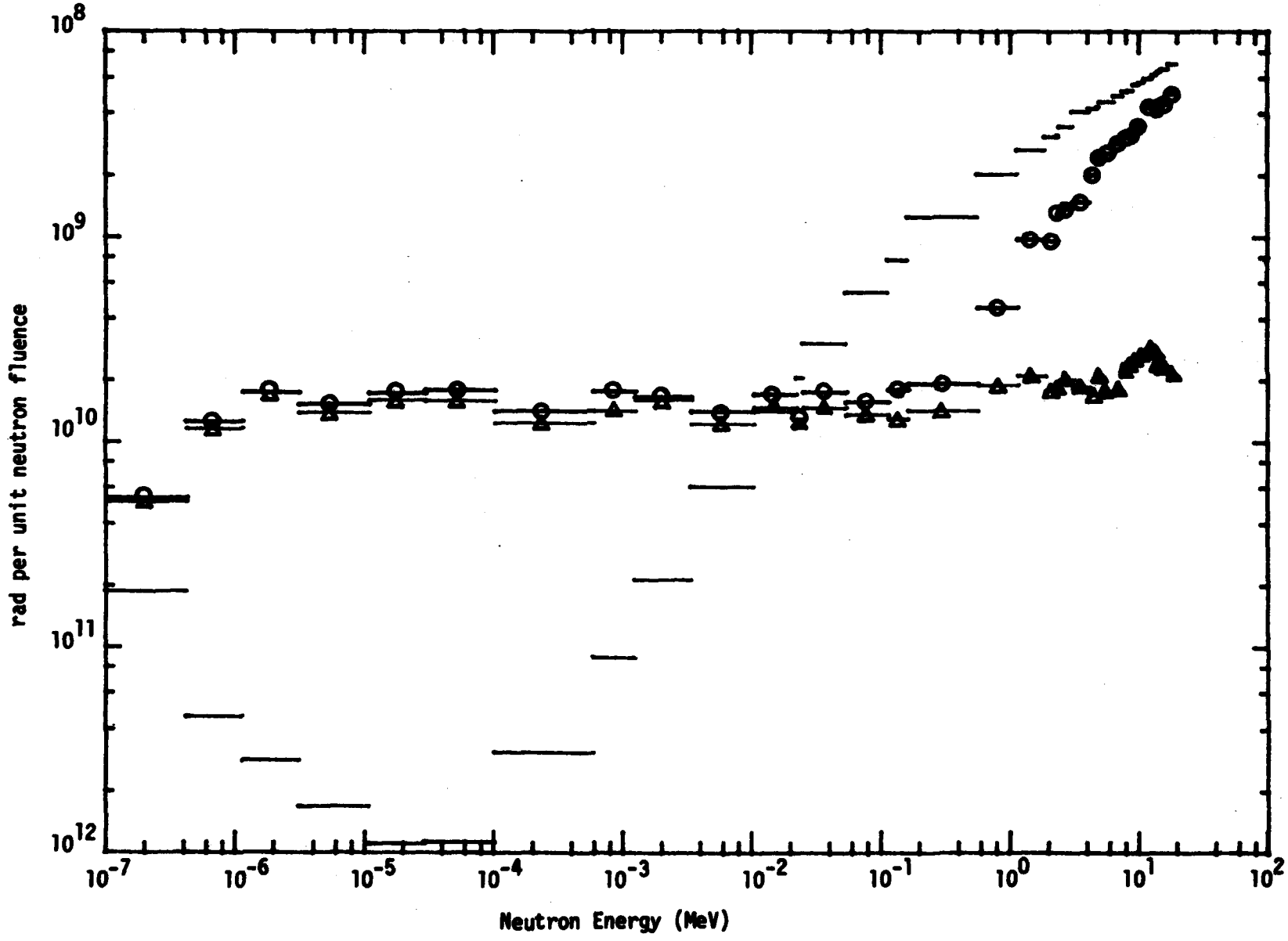


Figure III-13 Dose Deposition per Unit Neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Spine Active Marrow, Total (—⊖—) rad (red marrow)
N-γ (—△—) rad (red marrow)

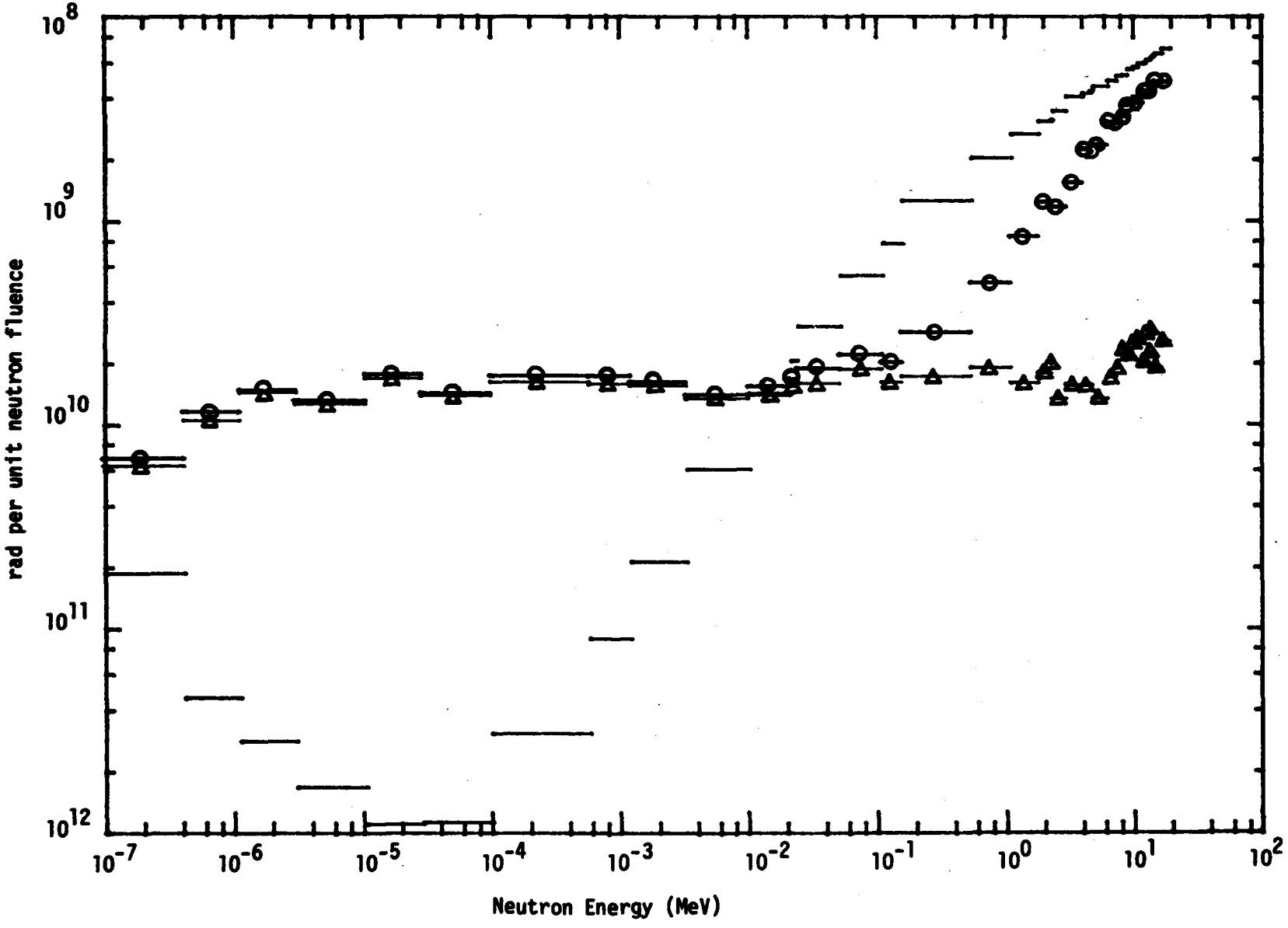


Figure III-14 Dose Deposition per unit neutron fluence
Tissue Kerma free-in-air (———) rad (tis)
Skull Active Marrow, Total (—o—) rad (red marrow)
N-γ (—Δ—) rad (red marrow)

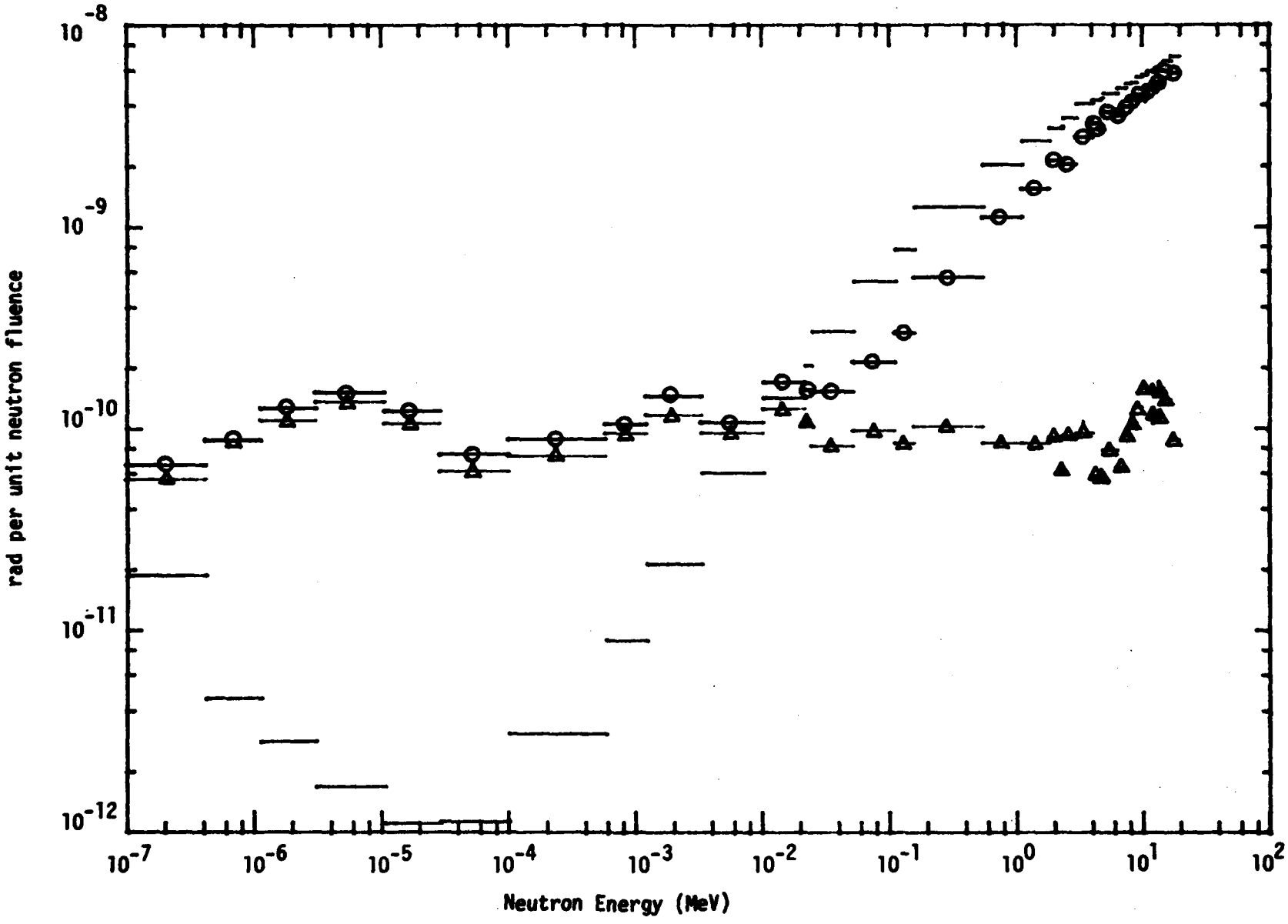
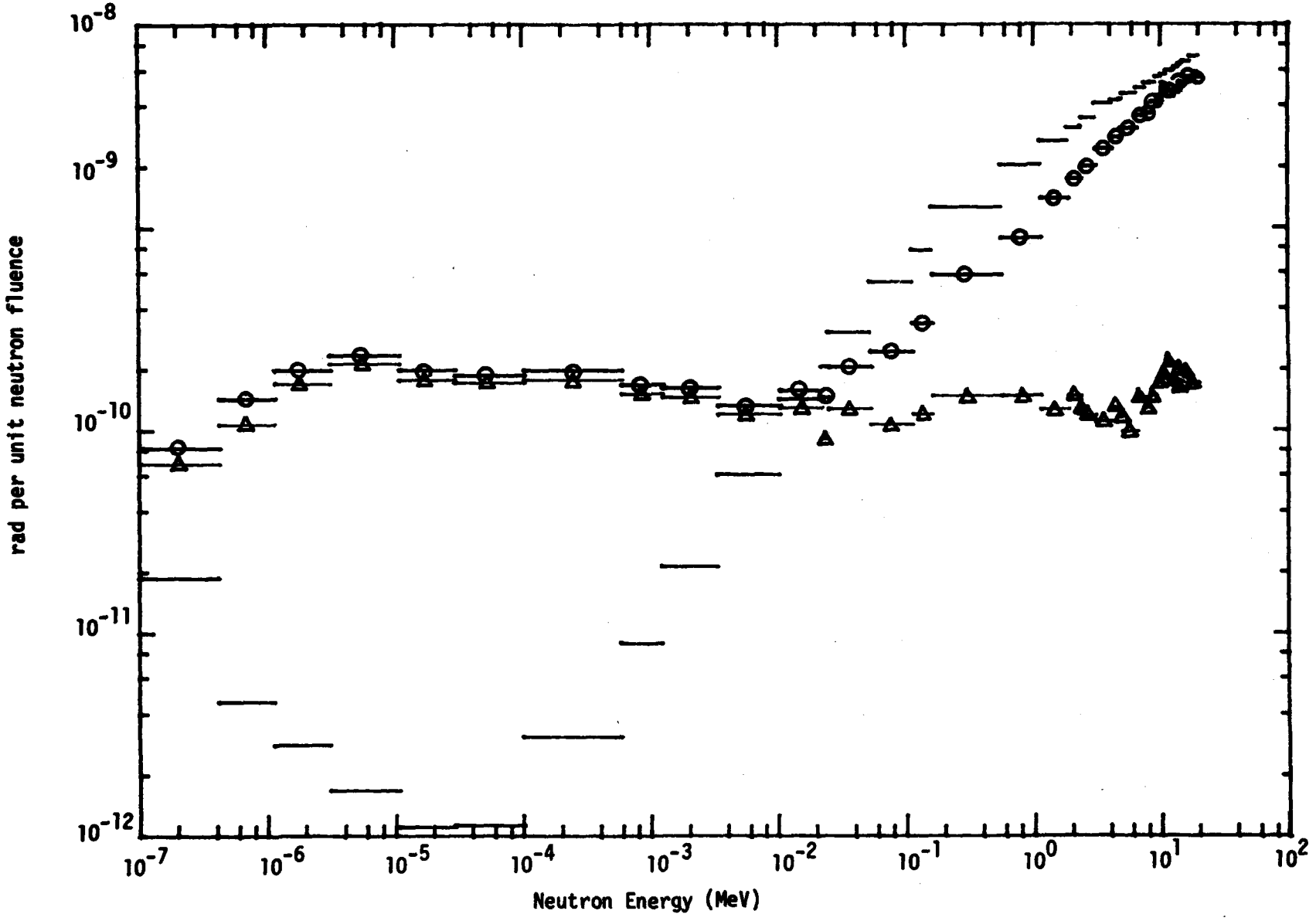


Figure III-15 Dose Deposition per Unit Fluence
Tissue Kerma free-in-air (———) rad (tis)
Rib Active Marrow, Total (—o—) rad (red marrow)
N-γ (—Δ—) rad (red marrow)



ANGLE DIFFERENTIAL RESULTS

Results of the dose deposition calculations are tabulated in Appendix C as adjoint exit fluences in twelve equal solid angle bins and in five polar angle bands averaged over azimuth. The orientiation of these bins relative to the reference man phantom is shown in Figure III-16. The azimuthal averaged values are presented for reference man as a whole. The binned values pertain to active marrow located on the right (positive X) side of the phantom only and are presented for reference man and for all eight marrow regions. To obtain the angular differential dose deposition factors for marrow located on the left (negative X) side of the phantom, the recorded azimuthal response values must be transposed across the Y-Z plane. The dose deposition for the total marrow (positive and negative X) of any body region in a particular azimuth angle bin is the average of the calculated and transposed value for that bin. From Figure III-15 it can be seen that this procedure will apply to three pairs of azimuthal bins, 2 and 3, 5 and 7, and 9 and 10.

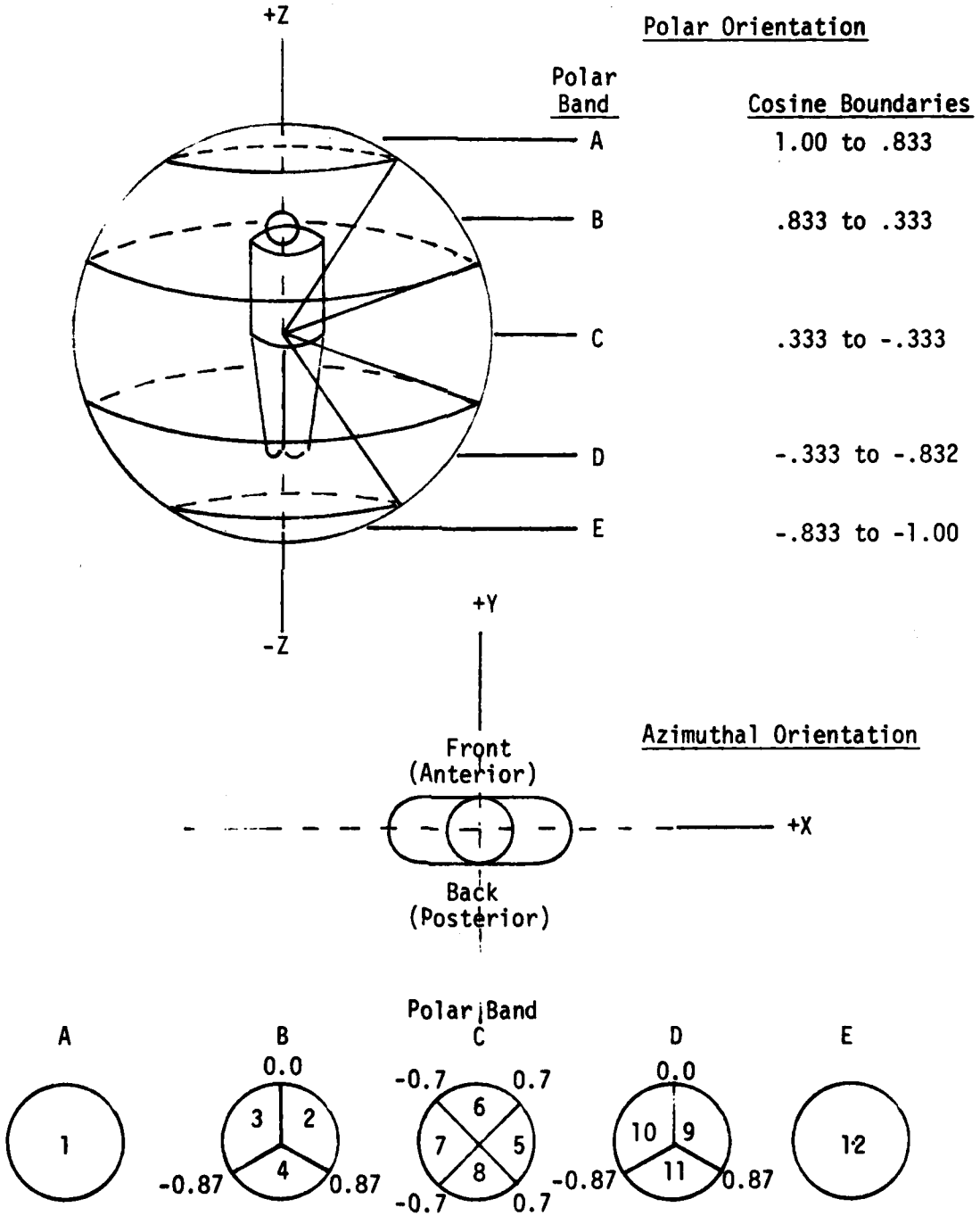
Figures III-17 through III-22 depict angular differential dose deposition factors (adjoint exit fluence) for neutrons and gamma rays in several representative energy groups. Data are presented for polar angle dependence with azimuthal symmetry and azimuthal dependence in polar angle band C, corresponding to the midplane of the reference man phantom. Cosine values pertain to adjoint exit fluence directions, as shown in Figure III-16. These are in opposition to the directions of the corresponding incident fluences, the true orientation of which are given in parentheses. A-P refers to the direction from phantom anterior to phantom posterior or frontal exposure to an incident fluence. P-A refers to the opposite of this.

Polar angle dependencies for all modes of dose deposition are similar in that incident radiation in the upward or downward direction is less effective at depositing dose in the marrow than is that from other directions, particularly at and just above the phantom midplane. This effect increases with decreasing radiation energy and is most pronounced for incident neutrons.

Azimuthal angle dependencies are similar for gamma ray and neutron (n-n) dose deposition. Both radiation types are more effective at depositing dose in the case of posterior incidence on the phantom than for other angles. This effect also increases with decreasing radiation energy and is more pronounced for incident neutrons. Neutron induced gamma ray (n-γ) deposition favors both posterior and anterior incidence over that from the side, with posterior gaining ascendency only at low neutron energies.

The angular dependencies noted above are a direct result of the location of the marrow, which is predominately deep in the trunk of the body but not symmetric about its centerline. These data are the most differential recorded for these calculations and therefore exhibit the worst statistical variance. However, there is a consistency in the angular dependent behavior of all three response types which extends over the entire energy ranges considered, the general nature of which is described above. There are of course some deviations from such consistent behavior trends. Such deviations are exhibited by neutron dose deposition for incident neutrons in group 29 (1.23 to 3.35 keV). However, an examination of angular differential dose deposition for other neutron energies in the vicinity of that group indicates that this deviation is an isolated incidence. Though other such deviations do exist, the general consistency of the angular differential results would seem to show that they may be used together with angular differential fluence to obtain integral dose values which are more reliable than statistical variance alone would indicate.

Figure III-16 Solid Angle Bin Orientation for Adjoint Fluence Exit (1.0472 steradians per bin)



Azimuthal Bins and Cosine Boundaries

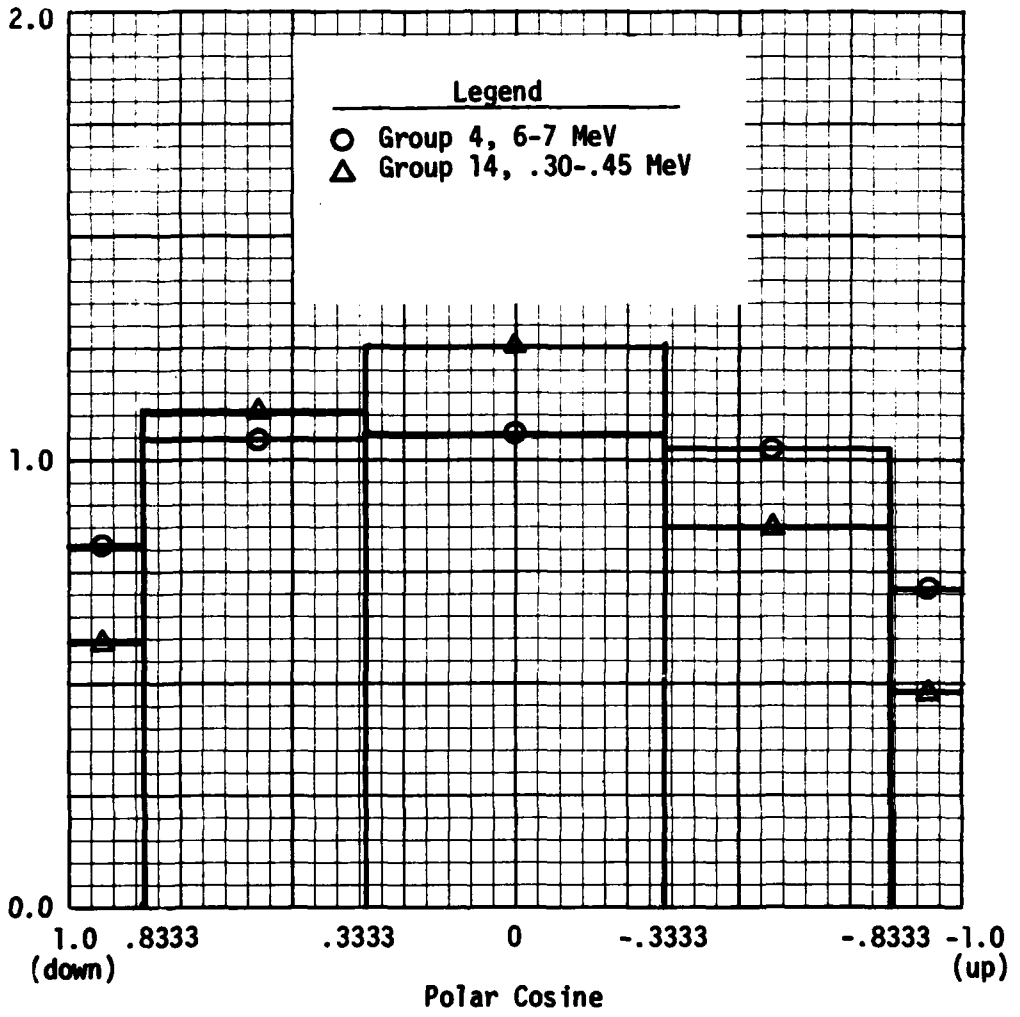


Figure III-17. Active Marrow Dose Deposition In Reference Man from Incident Gamma Rays In Five Polar Angle Bands as a Fraction of the 4π Angle-Integrated (isotropic) response.

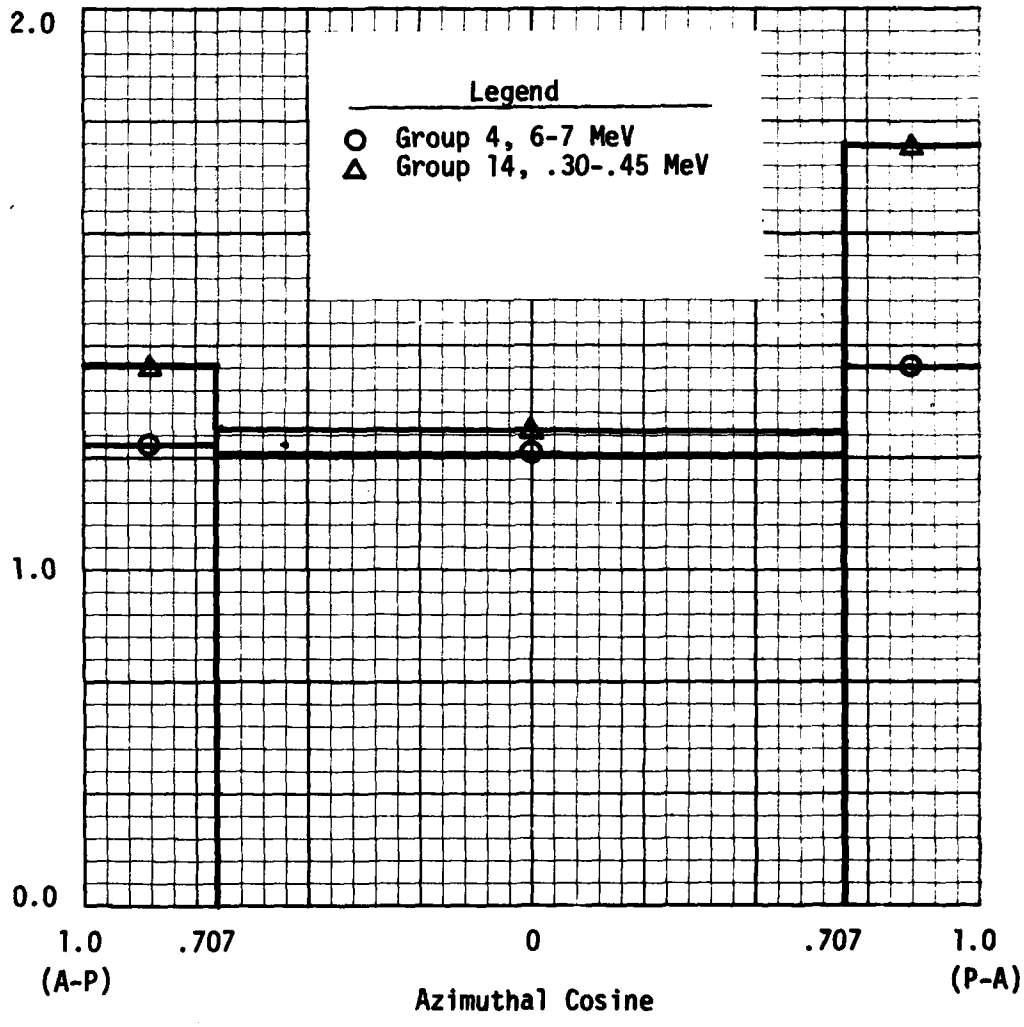


Figure III-18. Active Marrow Dose Deposition In Reference Man from Incident Gamma Rays in Three Azimuthal Angle Bins in the Phantom Midplane as a fraction of the 4π Angle Integrated (isotropic) Response.

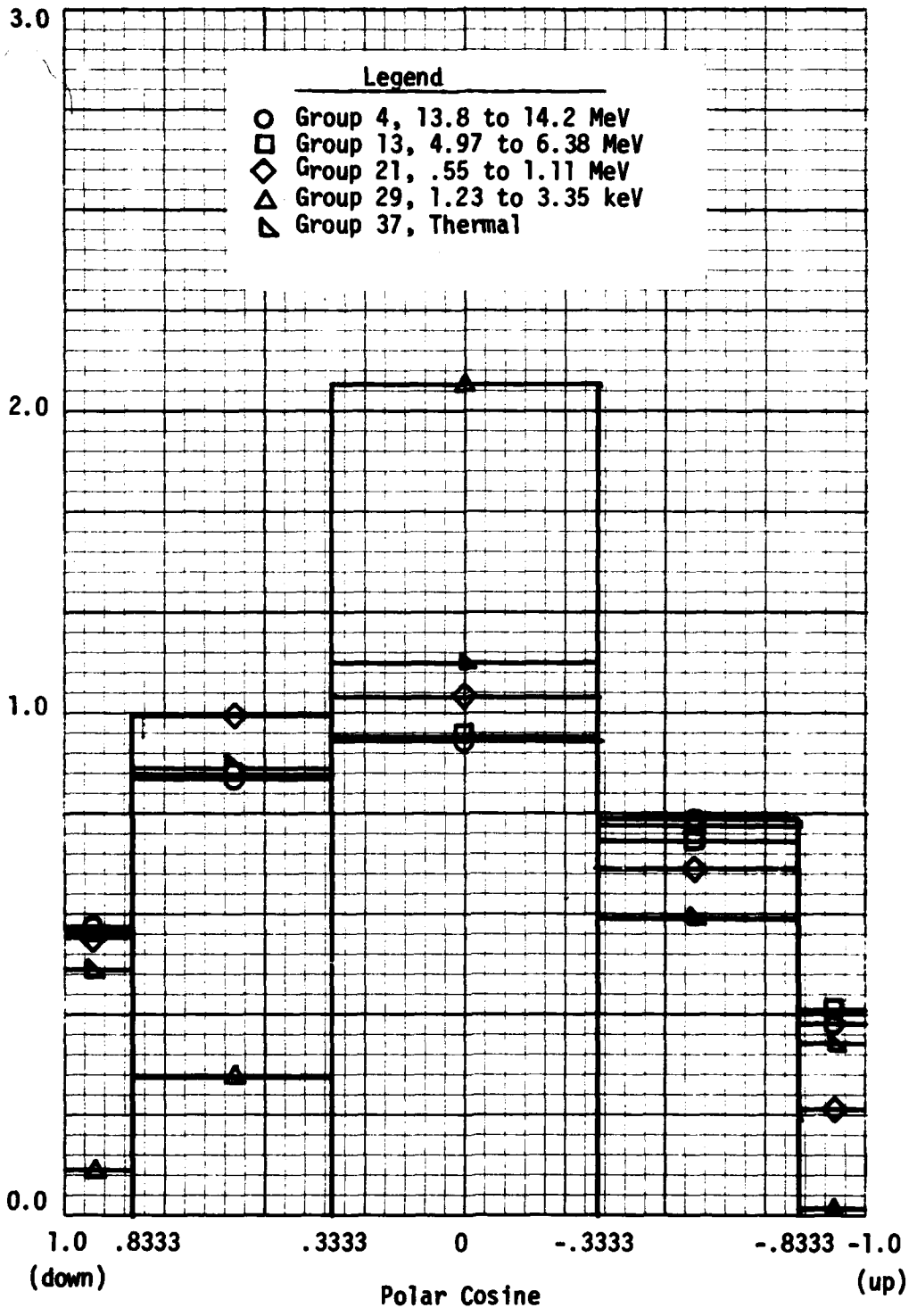


Figure III-19. Active Marrow Neutron Dose Deposition (n-n) in Reference Man from Incident Neutrons in Five Polar Angle Bands as a Fraction of the 4π Angle-Integrated (isotropic) n-n Response.

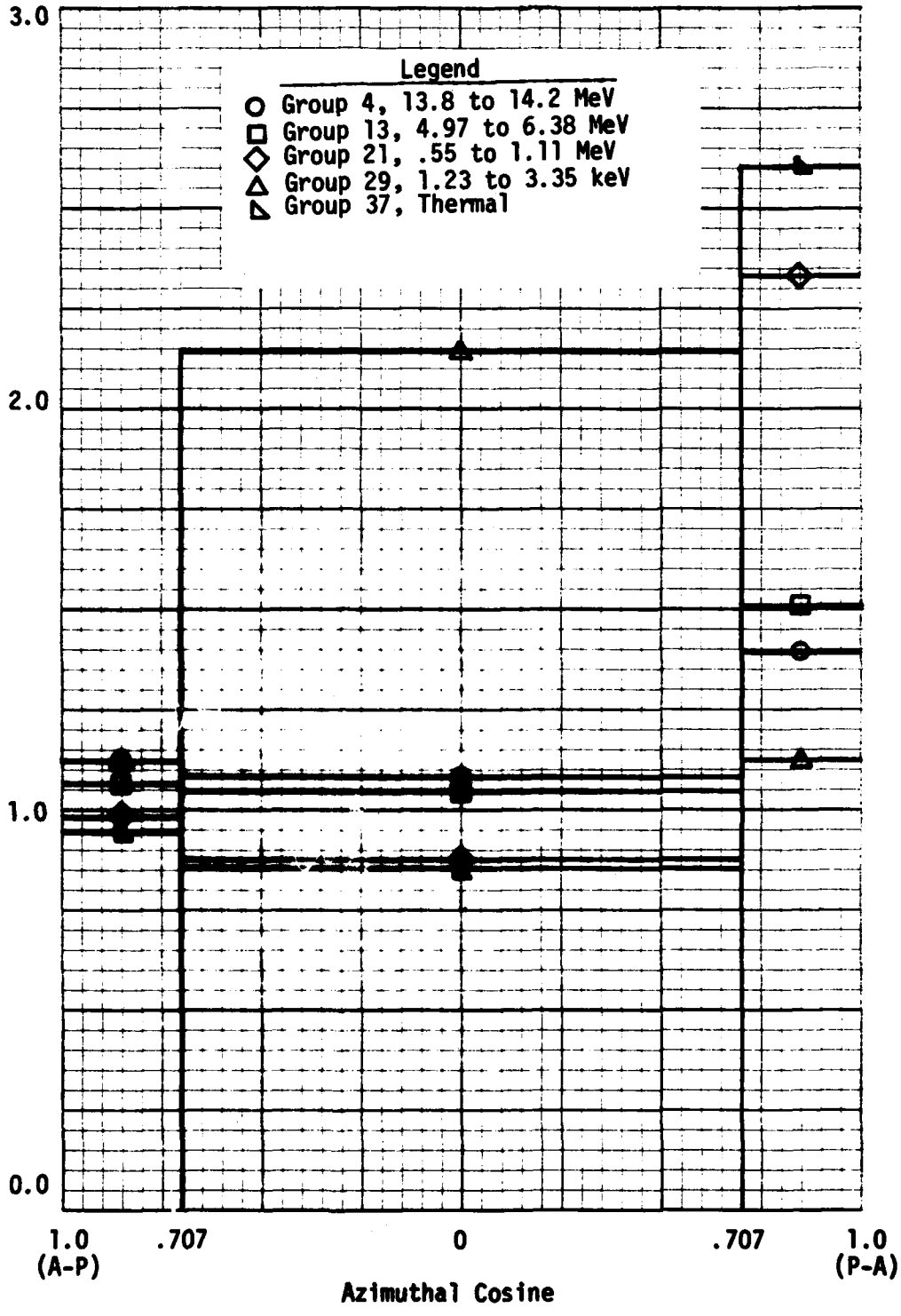


Figure III-20. Active Marrow Neutron Dose Deposition (n-n) in Reference Man from Incident Neutrons in Three Azimuthal Angle Bins in the Phantom Midplane as a Fraction of the 4π Angle-Integrated (isotropic) n-n Repsonse

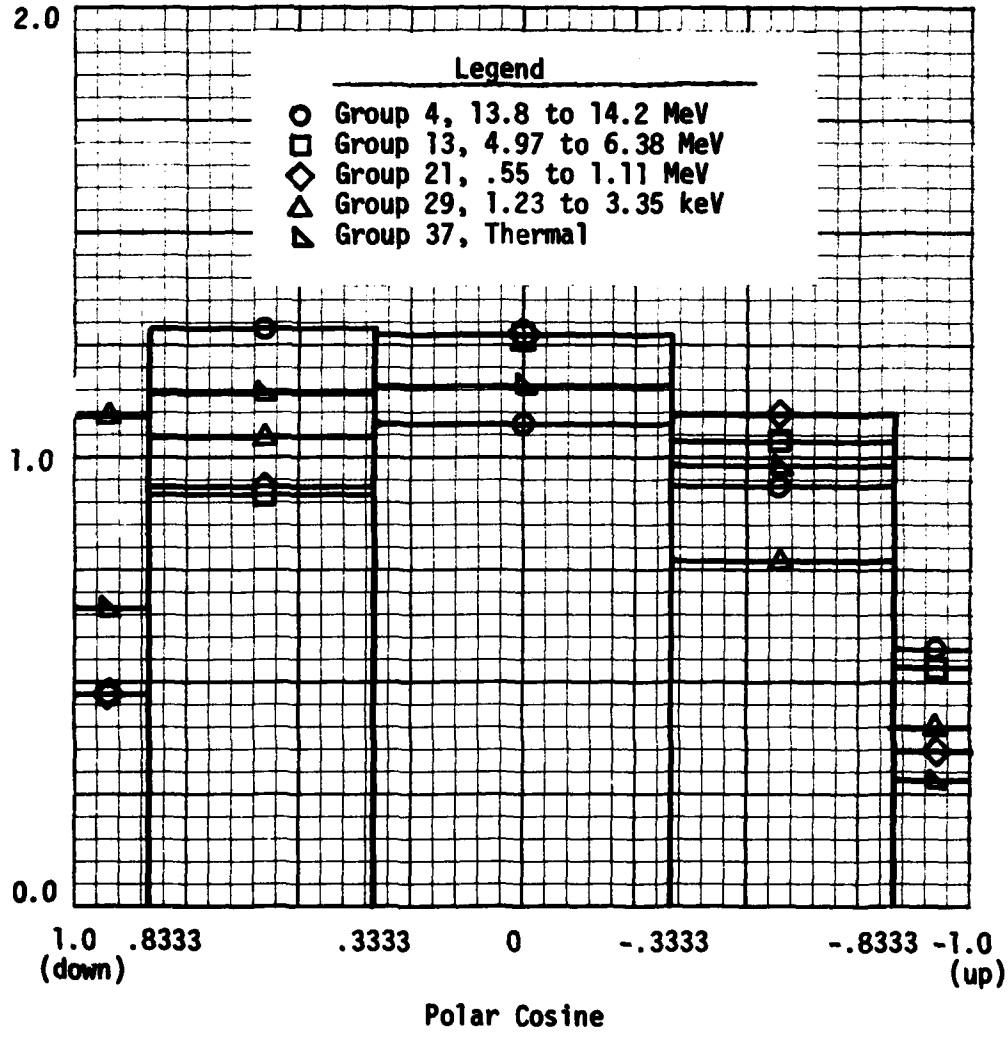


Figure III-21. Active Marrow Gamma Ray Dose Deposition in Reference Man from Incident Neutrons (n-γ) in Five Polar Angle Bands as a Fraction of the 4π Angle-Integrated (isotropic) n-γ Response

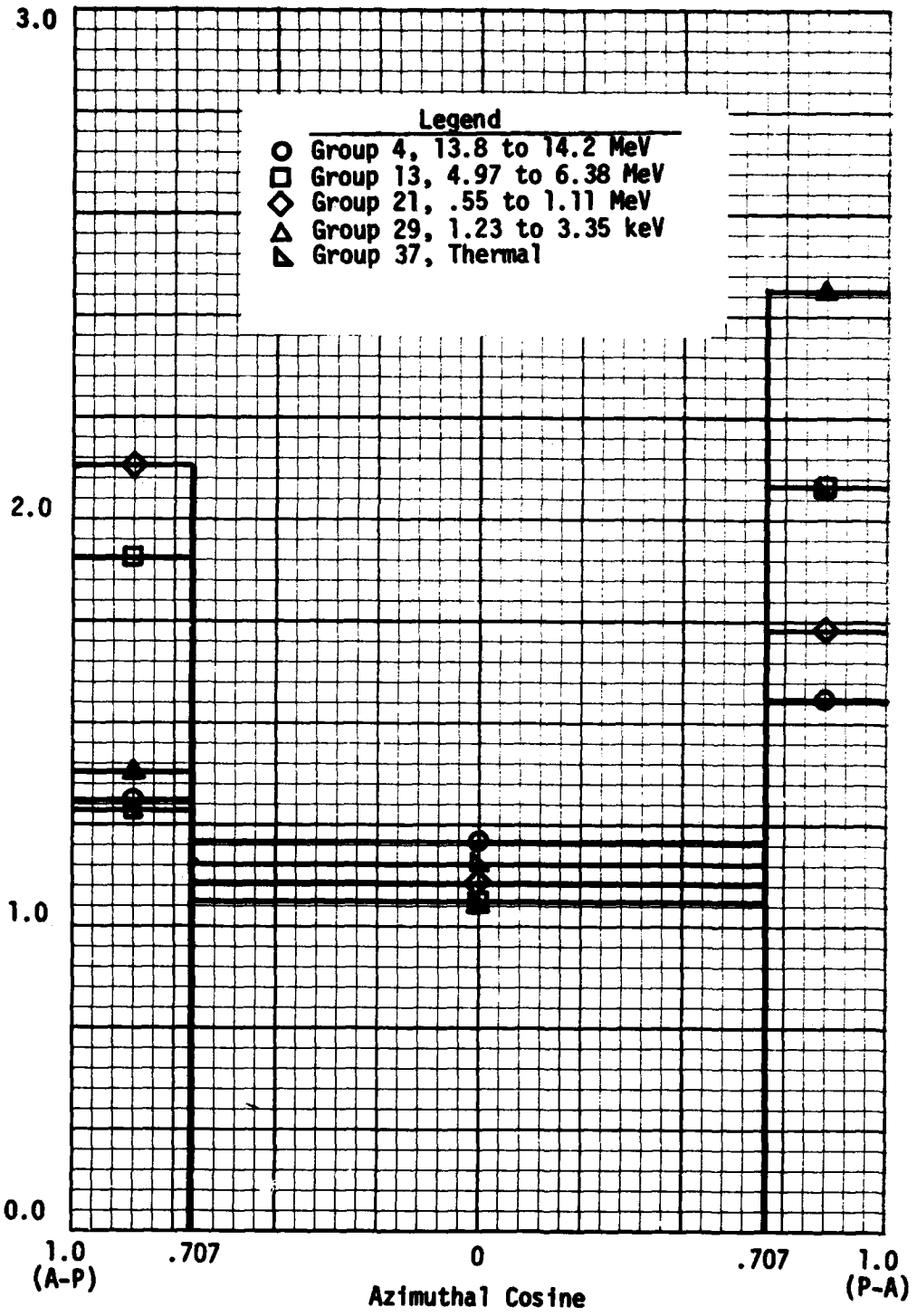


Figure III-22. Active Marrow Gamma Ray Dose Deposition in Reference Man from Incident Neutrons (n-γ) in Three Azimuthal Angle Bins in the Phantom Midplane as a Fraction of the 4π Angle-Integrated (isotropic) n-γ Response.

SECTION IV

MARROW DOSE FROM NUCLEAR WEAPONS RADIATION

Calculations were made to determine marrow dose in reference man produced by four hypothetical weapon types and two real weapons, according to the parameters given in Table IV-1. Calculations of radiation transport in air were performed using ATR4.1 (18,19) and include contributions from neutrons, neutron-induced gamma rays, prompt gamma rays and debris gamma rays.

Total dose (rad(tis), Free-In-Air) and neutron and gamma ray components are plotted versus ground range in Figures IV-1 through IV-3 for selected weapon types. Energy spectra for neutrons and gamma rays, excluding debris gamma rays, were also obtained from ATR4.1. These spectra apply to transport in infinite homogeneous air and have been normalized to provide the correct integrated Free-In-Air (FIA) dose values for the air-over-ground case. The infinite air spectra approximation was necessitated by the lack of any available alternative source of energy-differential fluence data which may be related to realistic weapon output spectra. A study conducted by E. A. Straker (20) has shown that the actual spectra at the air-ground interface tend to be somewhat more energetic than those computed for infinite air, due to the increased absorption of the low energy scattered component by the ground. This effect is most pronounced for bursts at or near ground level and becomes less so as the height of burst increases. A second approximation concerning the transported radiation fluence spectra involves the debris radiation. Spectra for this component were assumed to be the same as that for the combined prompt and air-secondary component. This approximation results in an overestimate of debris gamma ray energy. Finally, radiation fluences were assumed to be isotropic. In fact, however, the gamma ray fluence

is approximately 10 times greater in the direction away from the burst than it is in the direction toward the burst. Available calculations (21) for transport from a very low air burst (15.2 m alt.) through 1200 m of air above the air-ground interface show the thermal neutron fluence ($0 < E \leq 4.4 \times 10^{-7}$ MeV) to be somewhat biased in the upward direction from the ground. Epithermal neutrons ($4.14 \times 10^{-7} < E \leq .111$ MeV) are virtually isotropic, while higher energy neutrons exhibit a net fluence in the direction away from the burst, which increases with neutron energy. For fission weapon neutrons in the energy range $.111 < E \leq 20$ MeV, the average ratio of fluence away from the burst to that toward it is a bit less than 2 to 1, while for an enhanced device it is a bit more. These high energy neutrons make up only 1/3 or less of the total transported neutron fluence from a fission weapon while they account for approximately 1/2 of that for an enhanced weapon. These approximations should be kept in mind as one reads the following discussion of the nature of weapon radiation deposition in human marrow.

Figures IV-4 through IV-8 present the average dose to the active marrow as it compares to tissue dose FIA, total and components, for the various weapons types identified in Table IV-1. The nearly constant 45° slope exhibited by the data indicates that little change takes place in the transported spectra of the radiation components over the range of interest. Differences in total marrow dose for various weapons at specific total dose FIA levels (Figure IV-4) is more indicative of variations in neutron to gamma ray free-in-air dose ratios than any other factor. This is shown more dramatically in Figure IV-5 in which neutron marrow dose is shown as it relates to total dose FIA. The World War II weapons have very low neutron to gamma ray FIA dose ratios. Those for enhanced radiation and other devices of the same yield are about the same at equivalent total FIA dose levels, while those for the

low yield devices are highest of all. However, because of its large high energy neutron component, the fluence from the enhanced radiation device is more effective at depositing neutron dose in the marrow than other devices. This is shown by the fact that the neutron dose deposited by a given total exposure from such a device is as much as that produced by devices having higher neutron to gamma ray FIA dose ratios. It is further born out by the information presented in Figure IV-6, which indicates that neutrons from the enhanced device are the most efficient at producing neutron marrow dose, while those from the World War II devices, particularly Little Boy are the least efficient. This effect is mitigated somewhat by the efficiency with FIA neutron dose is converted to gamma ray dose in the marrow, as shown in Figure IV-7. Because neutron-induced gamma ray marrow dose is a function of incident number fluence and not of neutron energy, those devices possessing lower average neutron fluence energies are more efficient at producing such doses for a given FIA neutron dose level. This is exactly the reverse of the case for neutron marrow dose. As a result, the total dose FIA is virtually the same for nearly all the weapon types examined here. An exception to this is Little Boy, which possesses a transported neutron fluence component of very low average energy. These neutrons produce considerable dose by capture in nitrogen with its attendant 626 keV proton emission, while at the same time the number fluence to produce a given FIA dose level is so high that the neutron-induced gamma ray marrow dose per unit neutron dose FIA is approximately twice that for other devices. In sum then the transported neutron fluence from the Little Boy device is approximately half again as efficient at producing total marrow dose per unit neutron dose FIA as is the case for any other weapon. Finally, as shown in Figure IV-8, the gamma ray marrow dose produced per unit gamma ray dose FIA is a virtual constant for all device types analyzed here.

The relationships between marrow dose and FIA dose components as depicted in Figures IV-4 through IV-8 are tabulated in Table IV-2, as coefficients for the formula

$$D_{marrow} = F_{\gamma-\gamma} D_{\gamma FIA} + (F_{n-n} + F_{n-\gamma}) D_{nFIA}$$

where

D_{marrow} is reference man marrow dose, rad (marrow),

$D_{\gamma FIA}$ and D_{nFIA} are, respectively, free-in-air gamma ray and neutron doses, rad (tis),

$F_{\gamma-\gamma}$ is the fraction of the free-in-air gamma ray dose converted to marrow dose, and

F_{n-n} and $F_{n-\gamma}$ are, respectively, the fractions of the free-in-air neutron dose converted into marrow neutron and gamma ray dose.

The values of these coefficients do not vary by more than a few percent over the range from 100 to 1000 rad (tis) FIA.

The relationships described above were derived for the purpose of relating average marrow dose to FIA dose, assuming isotropic incidence and infinite air spectra. Spectral variations will have little effect on the gamma ray marrow dose as it relates to the FIA dose, since the marrow dose deposition factors and the KERMA factors vary with energy in approximately the same manner over most of the energy range considered, and particularly at the higher energies which contribute the highest fraction of the gamma ray dose. On the other hand, the ratio of marrow response to tissue KERMA (FIA) for neutrons rises by a factor of 3 from group 24 (.052 to .111 MeV) to group 20 (1.1 to 1.8 MeV) and doubles again by group 4 (13.8 to 14.2 MeV). Therefore, accounting for the spectral hardening caused by the presence of the ground will increase the marrow neutron dose relative to the free-in-air neutron dose produced by the same fluence. In the case of the n-γ

marrow dose component the opposite effect takes place. This is caused by the decrease in number fluence required to produce the same FIA dose with the harder spectrum. A shift in effective neutron energy from 80 keV to 1.5 MeV decreases the fluence required to produce a given free-in-air dose by a factor of 5.5. Therefore, it is likely that, on the whole, spectral hardening due to the presence of the ground will result in a net decrease in marrow dose relative to a constant free-in-air dose.

The gamma ray marrow dose deposition in reference man is a very weak function of incident angle. Thus, even though the photon fluence is highly peaked in the direction away from the burst, the effect of this anisotropy is not likely to be very great. On the other hand, the neutron-induced gamma ray (n-γ) marrow dose component and the neutron (n-n) component show substantial angular dependence. This is especially true of the azimuthal angle of incidence in the midplane of the body, in which neutrons of all energies are approximately twice as effective at depositing dose in the marrow of reference man for a posterior incidence as they are for an anterior incidence. As noted earlier, neutrons above about 100 keV exhibit a strong directional bias away from the burst, which increases with neutron energy. As a result, for the case of a low air burst, the orientation of reference man, i.e., facing toward or facing away from the burst, will probably result in total marrow neutron dose extremes which are on the order of half or double the value for the isotropic case, respectively.

It does not take incident fluence anisotropy alone to produce nonuniform dose distribution in reference man, particularly from neutrons. Figures IV-9 through IV-11 show marrow dose distribution resulting from isotropically incident weapon radiation fluences produced by three very different weapons. Note that in all three cases the gamma ray (γ-γ) and neutron (n-n) dose to the submerged marrow in the pelvis, spine and legs is considerably less than that

deposited in the surface marrow, in the case of neutron dose by a factor of two or more. This is not the case for the neutron-induced gamma ray dose component. These gamma rays are produced throughout the mass of reference man with energies in excess of 2 MeV. Thus, their transport is little affected by the body and the amount of dose they deposit in any given region is determined mainly by geometrical considerations, i.e., the marrow location relative to that at which the gamma rays are being generated. The submerged marrow is surrounded by the torso and upper leg mass, which constitutes the majority of the reference man and is the region in which most of the gamma rays are produced. The rib cage surrounds most of this region. Therefore, it is expected that these marrow regions would receive the larger neutron-induced gamma ray dose, as indeed the case. It should be noted that these profiles, particularly those for neutrons, could look considerably different in the case of an anisotropic fluence which emphasized posterior exposure.

Table IV-1

NUCLEAR WEAPON PARAMETERS FOR DOSE CALCULATIONS

Weapon Type	Yield (kt)	Height of Burst (m)	Height of Detector (m)	Air Density (mg/cc)
1. Gun Assembly	5	104	1	1.13
2. Implosion, Fission	5	104	1	1.13
3. Implosion, Boosted Fission	5	104	1	1.13
	1	61	1	1.13
	.5	48	1	1.13
4. Enhanced Radiation	5	104	1	1.13
5. Little Boy (15) (Gun Assembly)	12.5	570	1	1.13
6. Fat Man (15) (Implosion)	22	500	1	1.13

Table IV-2

MARROW DOSE RAD MARROW (rad (marrow)) PER UNIT FREE-IN-AIR DOSE (rad (tis)) FOR SELECTED WEAPON TYPES

Weapon Type		$F_{\gamma-\gamma}$ (FSD)	F_{n-n} (FSD)	$F_{n-\gamma}$ (FSD)	$F_{n-n}+F_{n-\gamma}$ (FSD)
1. Gun Assembly		.72 (.040)	.26 (.136)	.26 (.181)	.52 (.158)
2. Implosion, Fission		.72 (.040)	.26 (.134)	.26 (.181)	.52 (.158)
3. Implosion, Boosted Fission	5 kt	.72 (.040)	.27 (.126)	.24 (.180)	.51 (.151)
	1 kt	.72 (.040)	.27 (.126)	.24 (.180)	.51 (.151)
	.5 kt	.72 (.040)	.27 (.126)	.24 (.180)	.51 (.151)
4. Enhanced Radiation		.71 (.041)	.34 (.098)	.18 (.176)	.52 (.125)
5. Little Boy		.72 (.040)	.22 (.179)	.40 (.188)	.62 (.185)
6. Fat Man		.72 (.040)	.26 (.130)	.25 (.181)	.51 (.155)

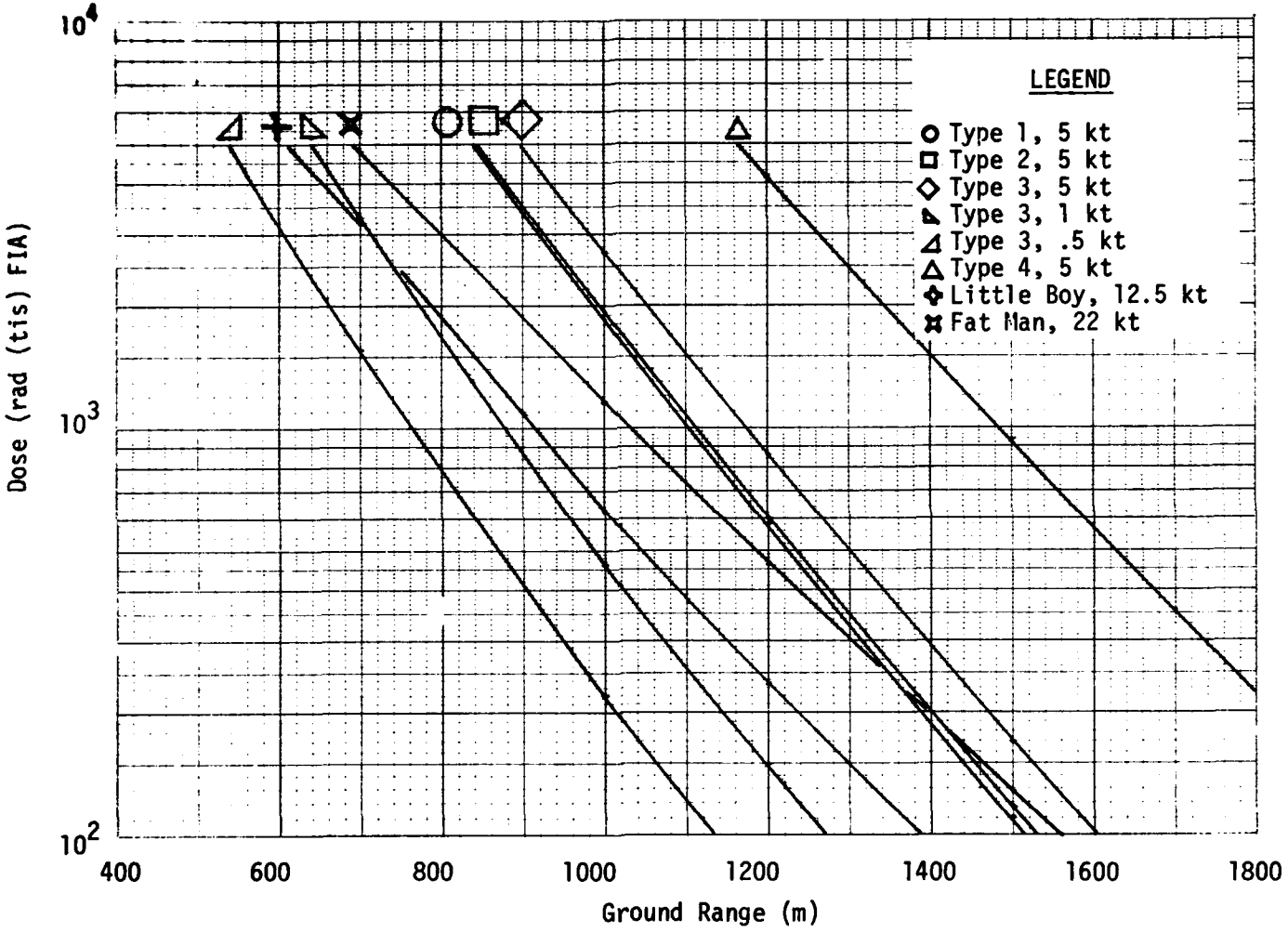


Figure IV-1. Total Radiation Dose (rad (tis) free-in-air) versus Ground Range (meters) for Eight Selected Weapon Types.

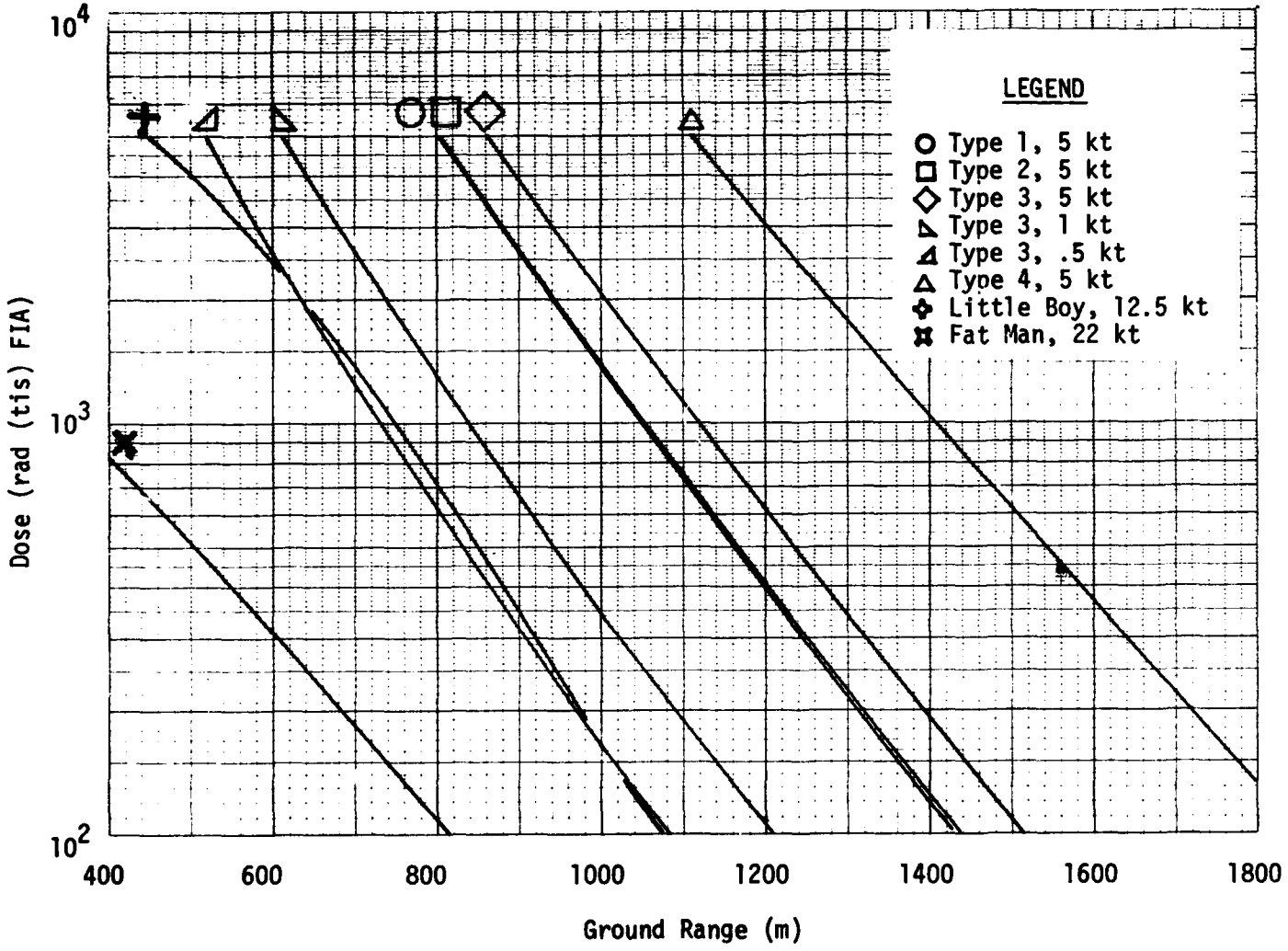


Figure IV-2. Neutron Radiation Dose (rad (tis) free-in-air) versus Ground Range (meters) for Eight Selected Weapon Types.

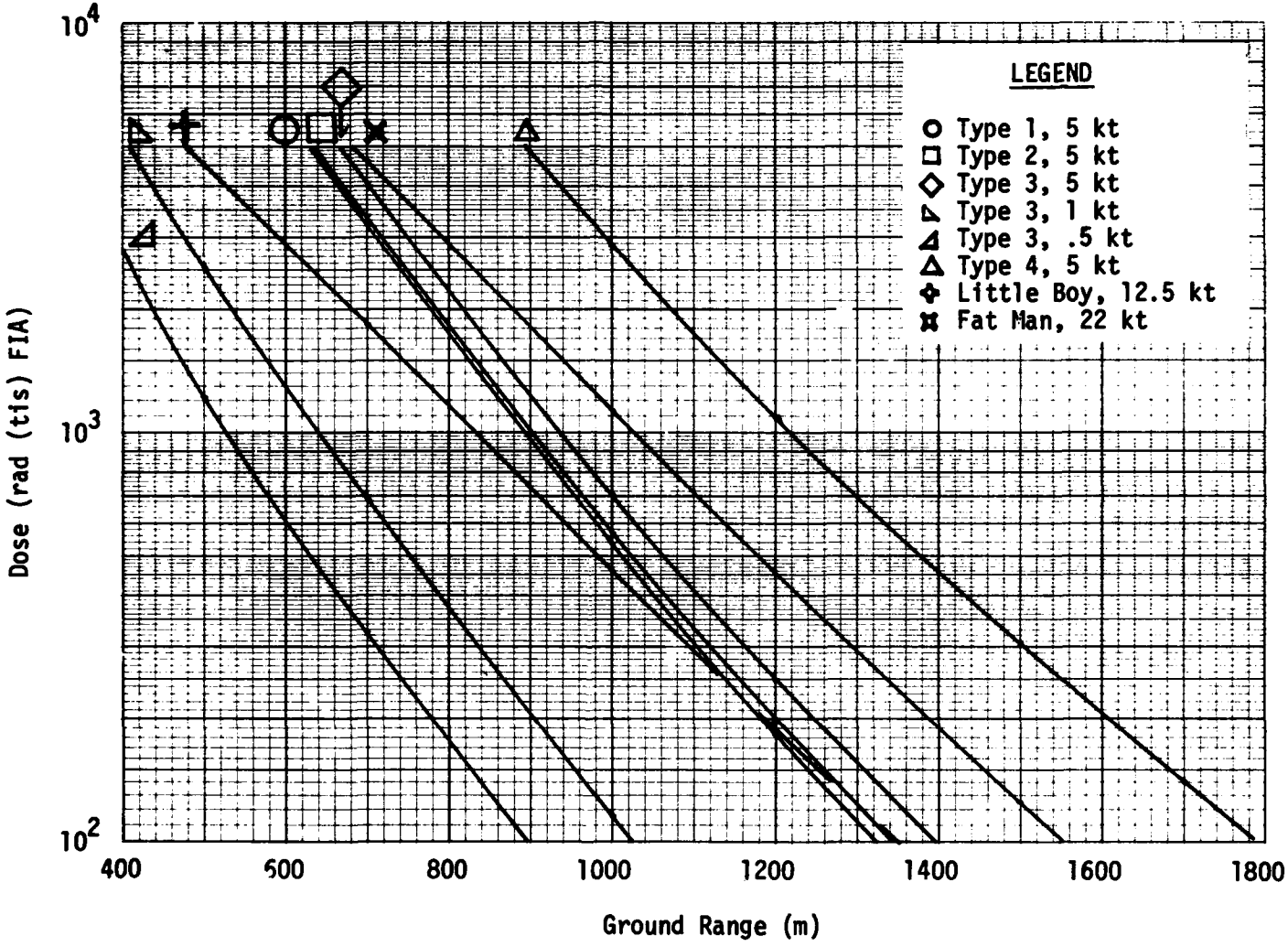


Figure IV-3. Gamma Ray Dose (rad (tis) free-in-air) versus Ground Range (meters) for Eight Selected Weapon Types.

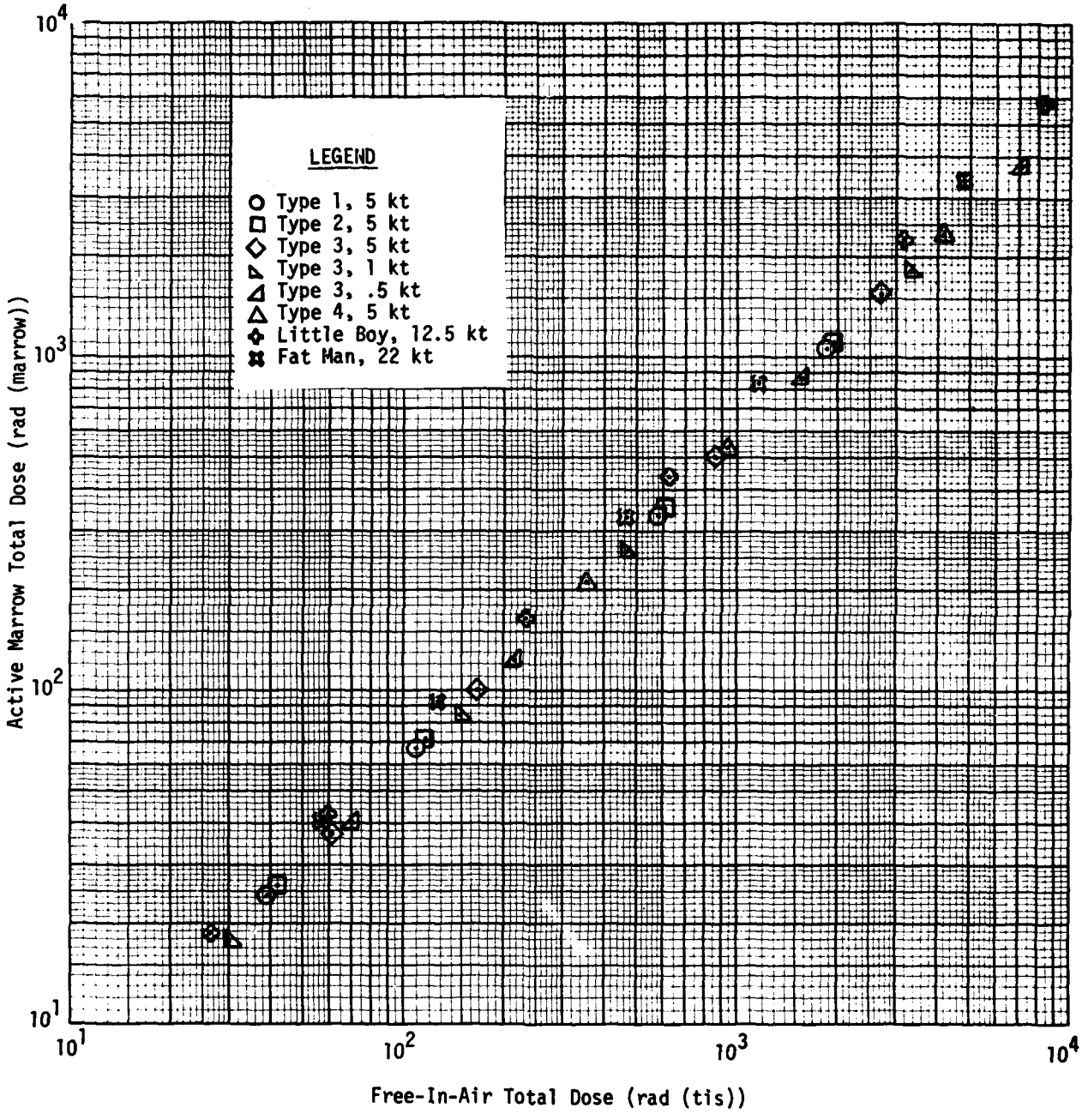


Figure IV-4. Active Marrow Total Dose (rad (marrow)) versus Free-In-Air Total Dose (rad (tis)) for Eight Selected Weapon Types.

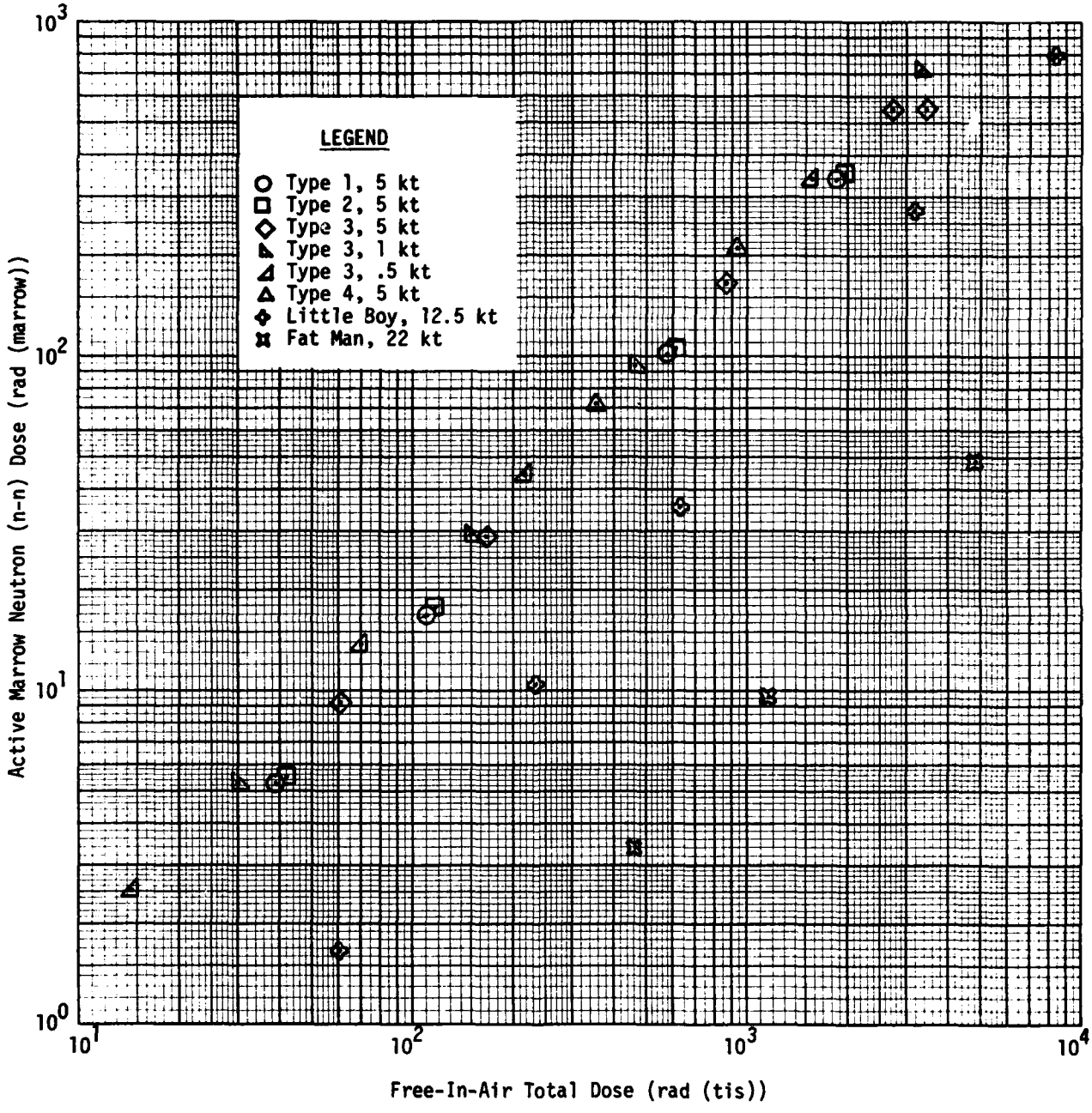


Figure IV-5. Active Marrow Neutron (n-n) Dose (rad (marrow)) versus Free-In-Air Total Dose (rad (tis)) for Eight Selected Weapon Types.

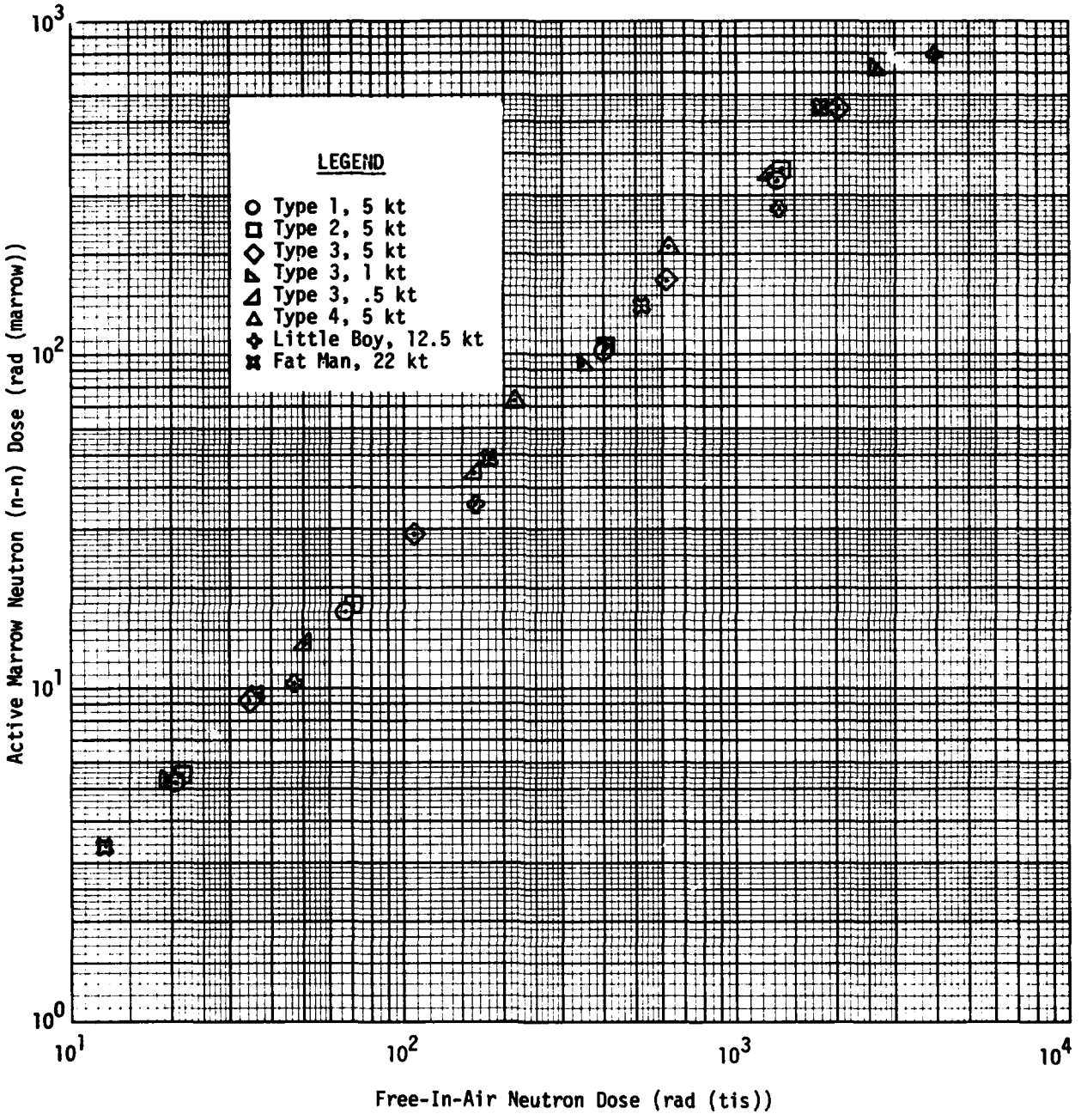


Figure IV-6. Active Marrow Neutron (n-n) Dose (rad (marrow)) versus Free-In-Air Neutron Dose (rad (tis)) for Eight Selected Weapon Types.

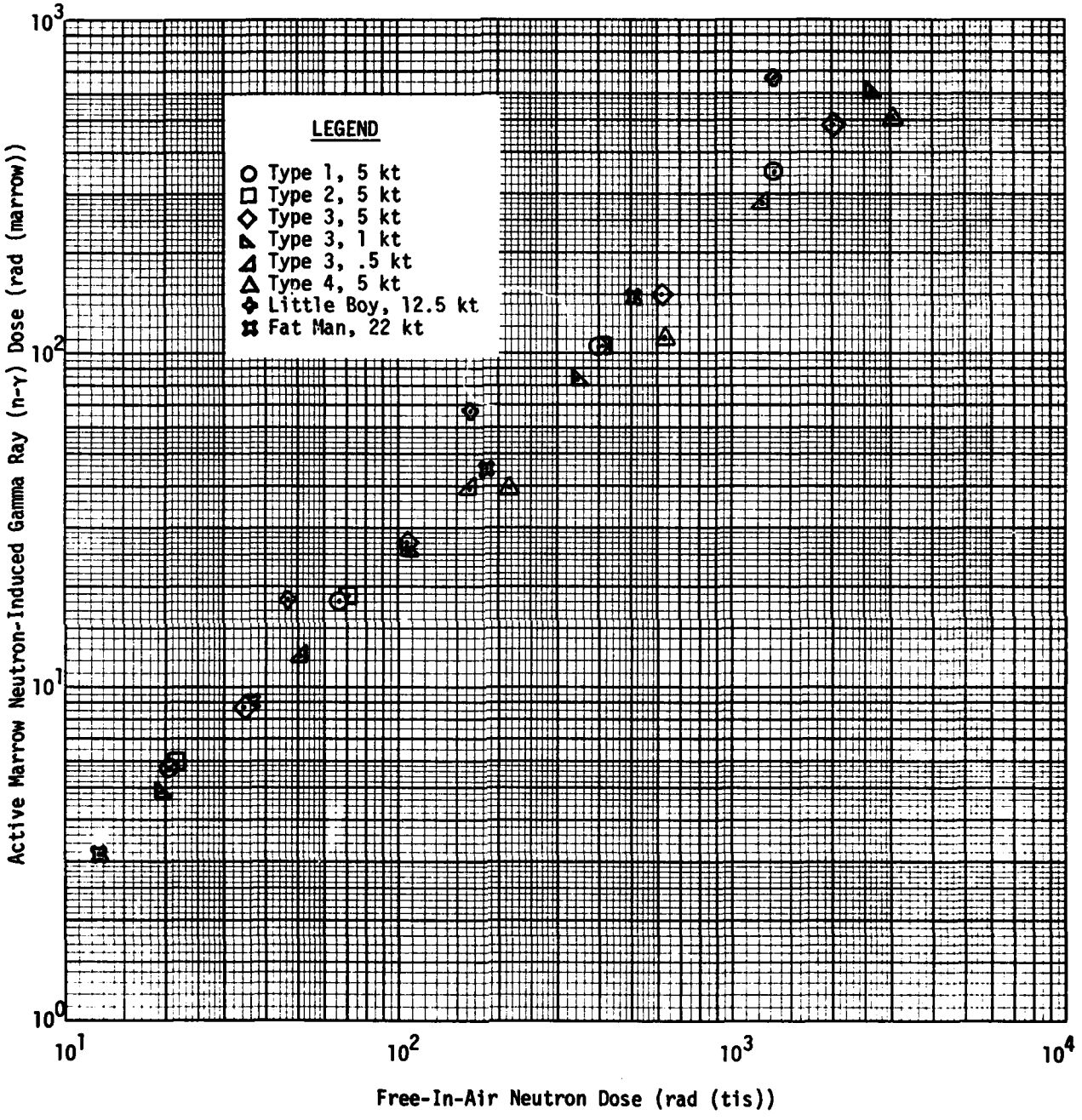


Figure IV-7. Active Marrow Neutron-Induced Gamma Ray (n-γ) Dose (rad (marrow)) versus Free-In-Air Neutron Dose (rad (tis)) for Eight Selected Weapon Types.

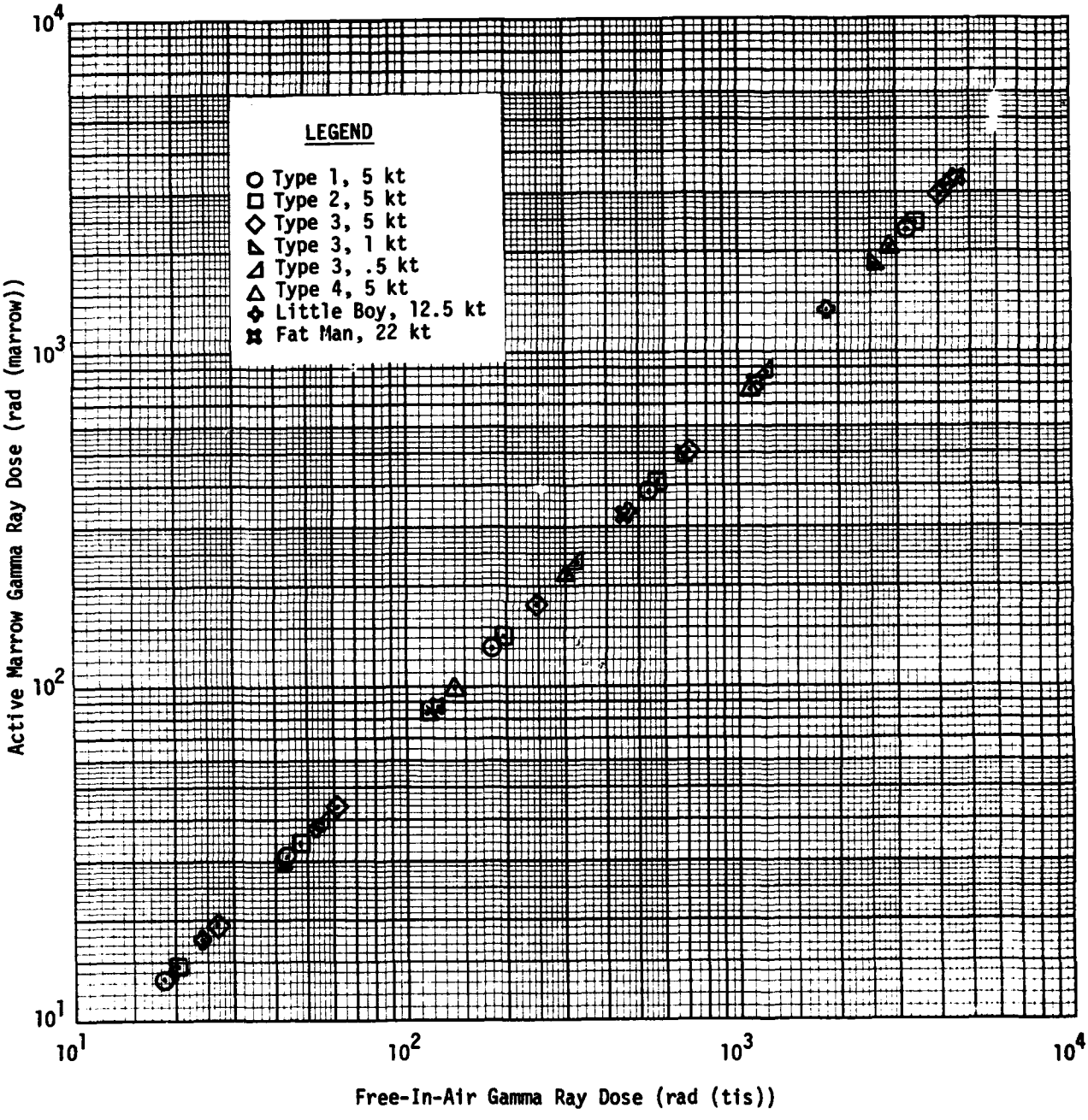


Figure IV-8. Active Marrow Gamma Ray Dose (rad (marrow)) versus Free-In-Air Gamma Ray Dose (rad (tis)) for Eight Selected Weapon Types.

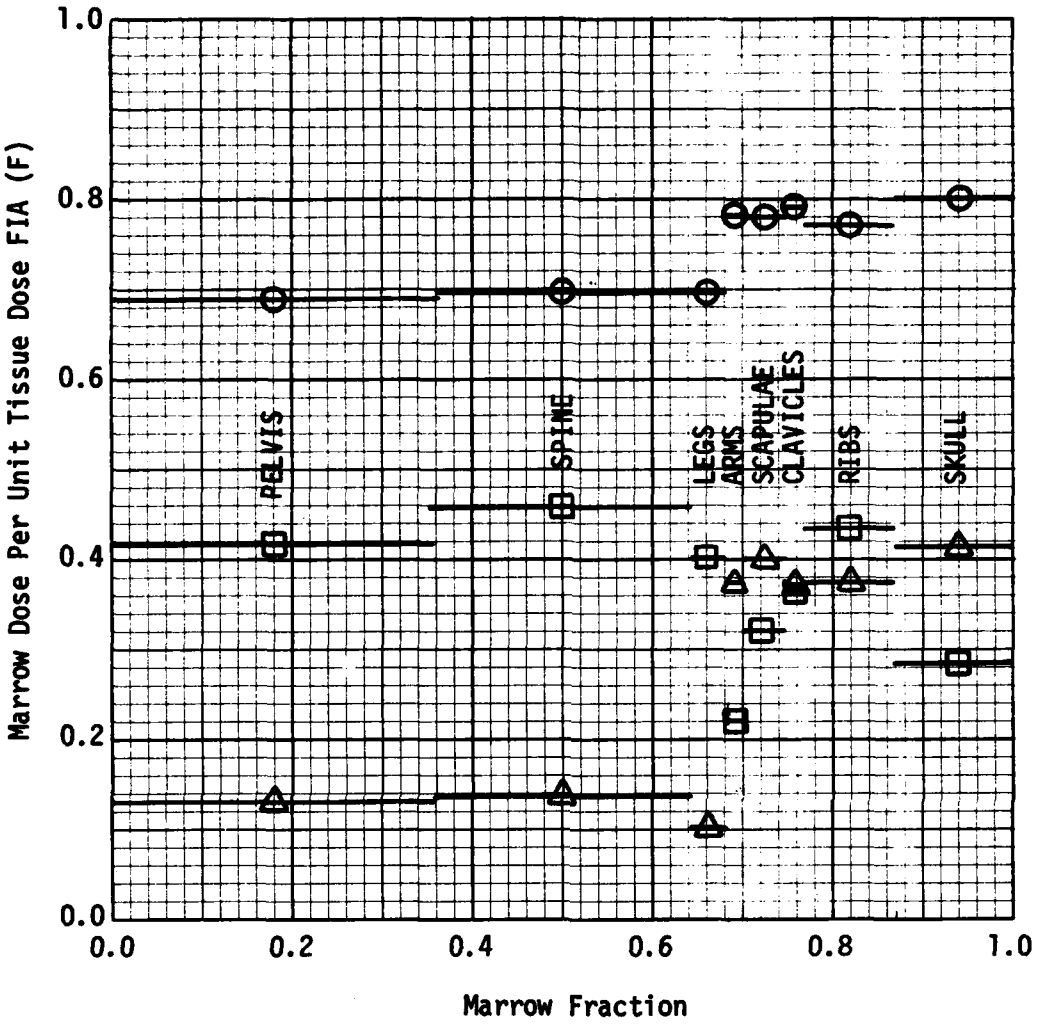


Figure IV-9. Marrow Dose Distribution Per Unit Incident Isotropic Fluence from Little Boy (12.5 kt, Ground Range = 1.0 km), O : $F_{\gamma-\gamma}$, Δ : F_{n-n}, □ : $F_{n-\gamma}$.

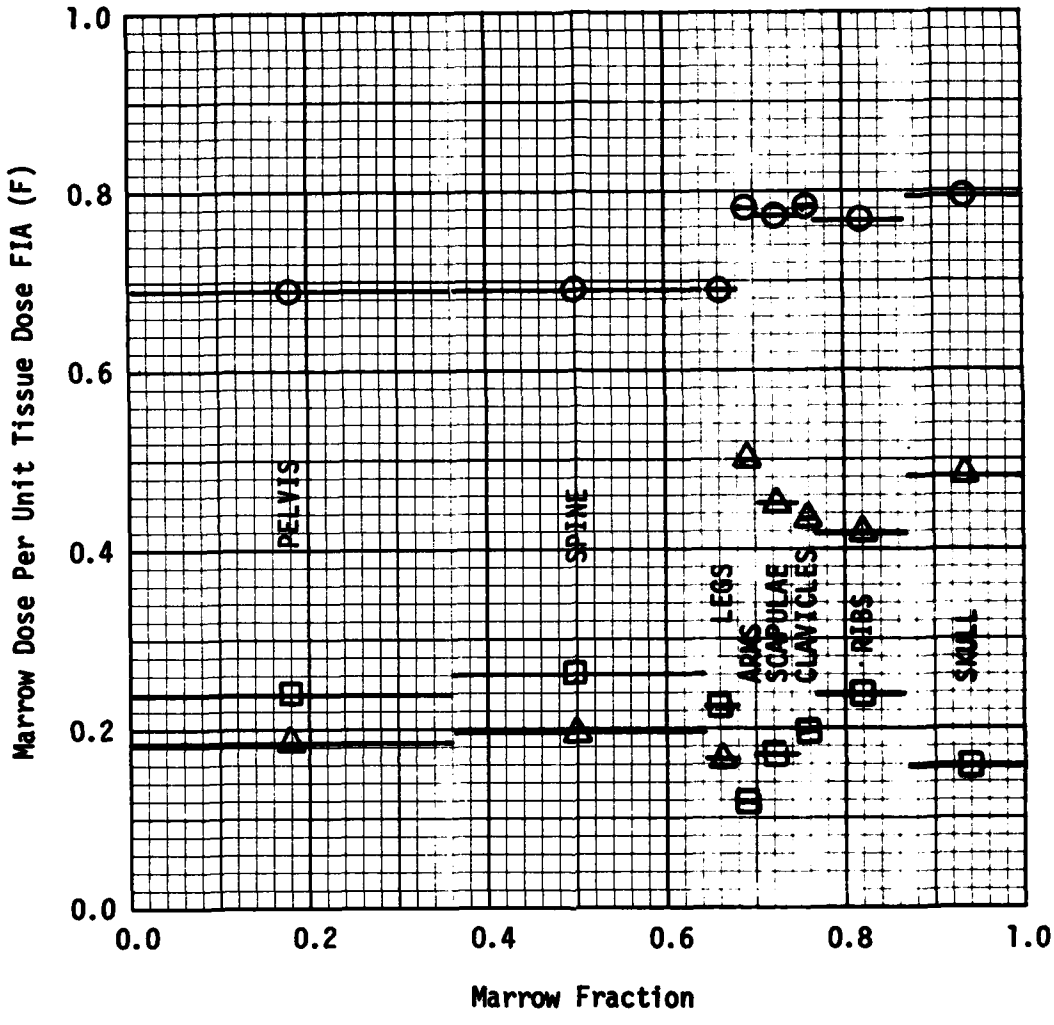
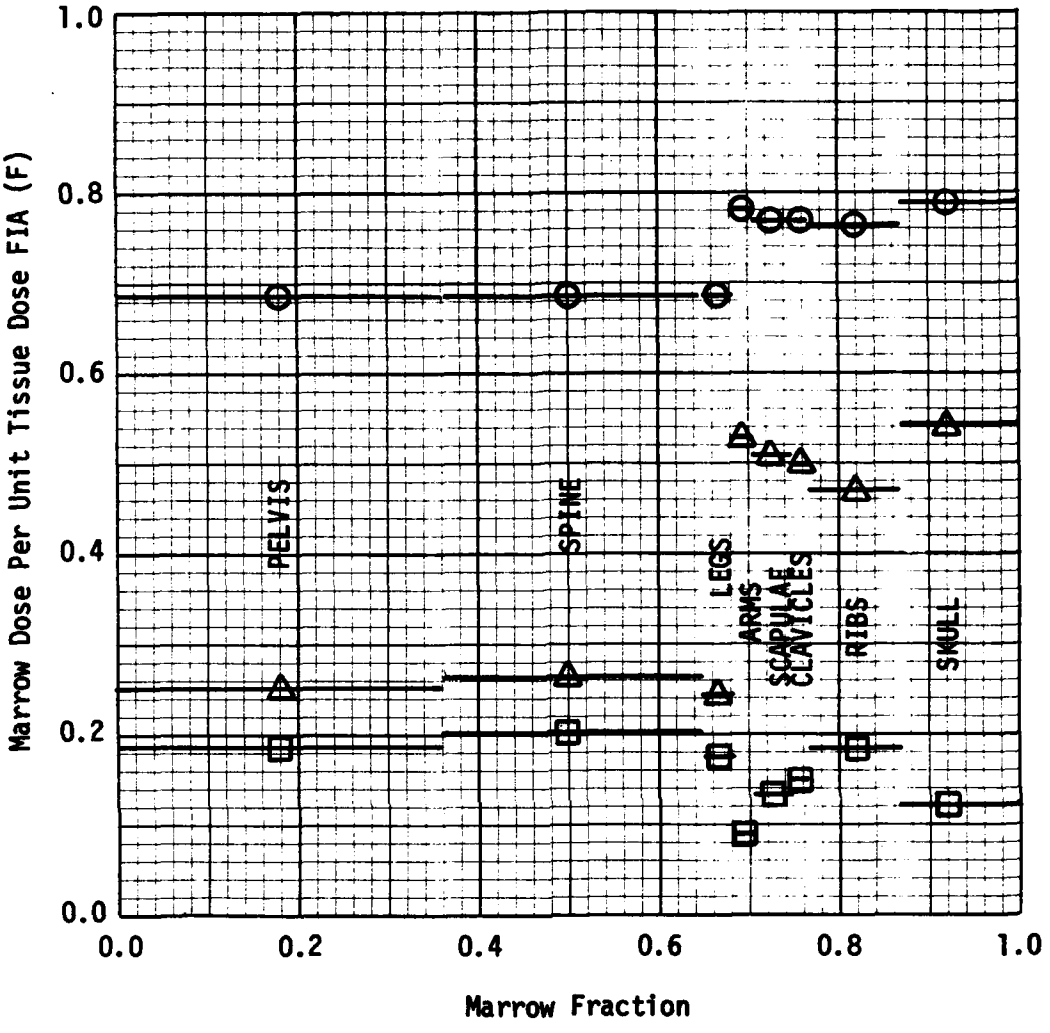


Figure IV-10. Marrow Dose Distribution Per Unit Incident Isotropic Fluence from a Boosted Fission Implosion Weapon (5 kt, Ground Range = 1.2 km), ○ : $F_{\gamma-\gamma}$, △ : F_{n-n}, □ : $F_{n-\gamma}$.



Figuve IV-11. Marrow Dose Distribution Per Unit Incident Isotropic Fluence from an Enhanced Radiation Weapon (5 kt, Ground Range = 1.5 km), O : $F_{\gamma-\gamma}$, Δ : F_{n-n}, □ : $F_{n-\gamma}$.

SECTION V
SUMMARY AND CONCLUSIONS

Dose deposition in the active bone marrow was calculated for reference man (11,12) using the MORSE Monte Carlo transport Code (4,5) in the adjoint mode. Calculations were performed using cross sections from the 37 neutron-21 gamma ray group DNA Few Group Library (6) with scattering angle dependence treated with a P_3 Legendre expansion. KERMA factors used in the calculation of dose were those for active marrow alone for neutron dose and active marrow plus trabecular bone for photon dose. The distinction was made to properly maintain the condition of local charged particle equilibrium required for KERMA use. Adjoint transport calculations resulted in dose deposition (rad (marrow)) values for eight marrow regions as a function of energy and angle differential neutron and gamma ray fluences externally incident on the man phantom. These regions and the relative amount of marrow in each are:

	Region	Total Active Marrow Fraction
1.	Pelvis	0.362
2.	Vertebrae (spine)	0.284
3.	Skull	0.131
4.	Ribs and sternum	0.102
5.	Scapulae	0.048
6.	Legs	0.038
7.	Arms	0.019
8.	Clavicles	0.016

Dose deposition (or response) functions for these regions were recorded for gamma dose from incident gamma rays (γ-γ) gamma dose from incident neutrons (n-γ) and neutron dose from incident neutrons (n-n). These were recorded in the energy group structure mentioned previously in angle-integrated and angle-differential form, the latter

being recorded in twelve equal solid angle increments. These values may be folded with any desired incident radiation fluence to obtain dose to the active marrow. The only condition for their direct use is that the man be situated in a radiation fluence which is uniform across his extremities. Man standing on an open plane meets this condition, man in a vehicle, in a foxhole or lying on the ground does not.

Calculated γ-γ and n-n response values show strong dependencies on the energy of the incident radiation. For γ-γ deposition this dependency closely follows that of gamma ray tissue KERMA. For n-n deposition, strong shielding of the marrow from high energy neutrons by the highly hydrogenous body mass results in a response value which decreases much more rapidly than neutron tissue KERMA down to energies of a few hundreds of keV. Below this energy the n-n deposition per unit fluence is independent of neutron energy. The reason for this is that neutrons in this energy range thermalize rapidly within the body and remain there to deposit the greatest part of their n-n component by thermal capture in nitrogen, which yields a 626 keV proton. The calculated n-γ response values show virtually no dependence on incident neutron energy. Instead they depend almost solely on the total incident neutron number fluence. As such they form a floor, below which the total neutron response cannot sink.

Calculated γ-γ response values show little dependence on angle of incidence with the man phantom. However, neutrons incident on the posterior in the midplane of the phantom are approximately twice as effective as depositing marrow dose as would be isotropically incident neutrons of the same energy.

Dose to the marrow has been calculated for radiation fluences from several hypothetical and real weapon types. These fluences reflect spectral characteristics of transport through homogeneous air and have been assumed to be isotropic. Results indicate that

all those weapon types considered are equal in the efficiency with which their associated free-in-air gamma ray dose environments deposit dose in the marrow (∿72%). With the exception of the Little Boy weapon, all are also nearly equal in the efficiency with which their associated free-in-air neutron dose environments deposit an average total dose in the marrow (∿52%). However, the neutron environment from the enhanced radiation weapon deposits two-thirds of this average by direct neutron interaction (kinetic energy transfer and charged particle emission), while the more conventional nuclear devices deposit only about half the average in this manner. The Little Boy weapon is a special case, possessing an exceptionally large transported low energy neutron component and having an average total marrow dose/free-in-air tissue dose conversion efficiency of 62%. Of this total only about a third is deposited by direct neutron interaction; the remainder are deposited by neutron-induced gamma rays.

The marrow dose calculations described above also indicate that the dose components are not uniformly distributed, even for the case of isotropic incidence. This is particularly true of the direct interaction neutron component. Neutron environments for all weapon types considered deposited at least twice the direct interaction dose in the 32% shallow marrow (skull, ribs, scapulae, arms, clavicles) as in the 68% deep marrow (pelvis, spine, legs). Weapon gamma ray environments display a similar bias, but to a much lesser extent, about 1.15 to 1. On the other hand, neutron-induced gamma rays deposit their dose preferentially in the deep marrow, which is central to the region in which they are produced, and in the ribs, which surround a large portion of that region. The extent to which this is the case is sufficient to produce an almost uniform gamma ray dose over the marrow in reference man exposed to weapons radiation having a neutron to gamma ray dose ratio of unity.

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RADIATION DOSE DEPOSITION IN THE ACTIVE MARROW OF REFERENCE MAN--ETC(U)
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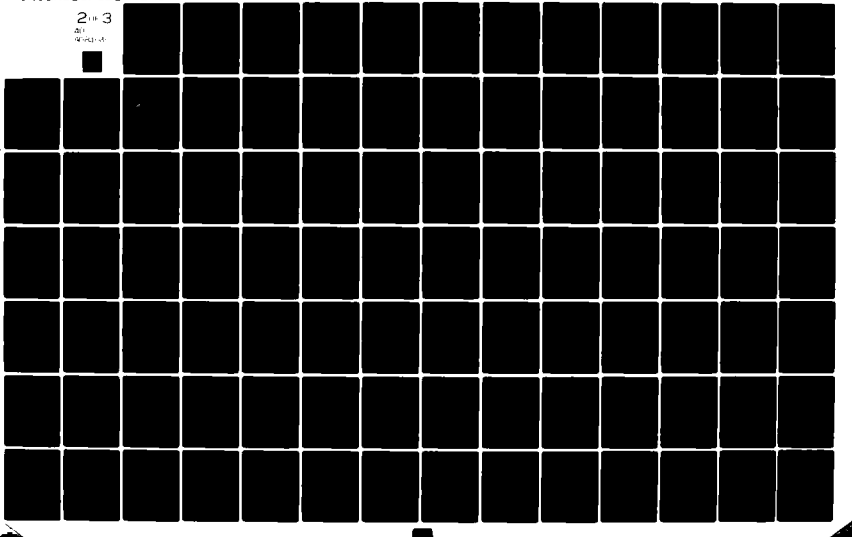

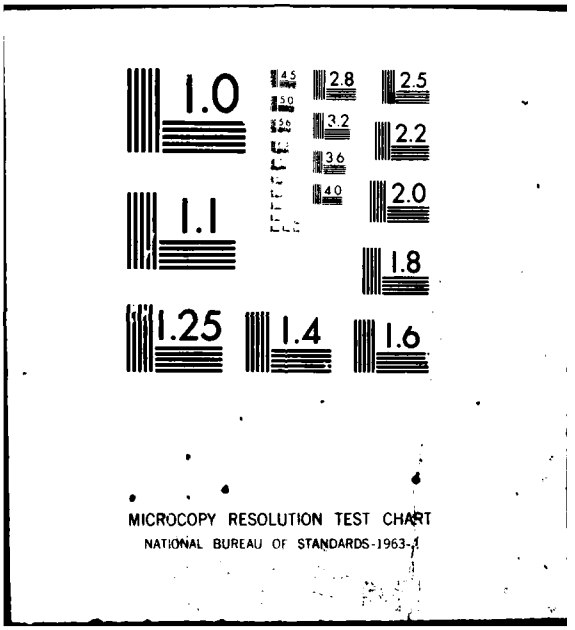
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

These calculations have been performed with the best available man model, code and cross sections. The man model is a free-world standard. The code and cross sections have been extensively tested against experiment and previously calculated data (22). The overall fractional standard deviation (FSD) of the total marrow doses calculated for the example weapon types are less than 0.11. The resulting confidence in the results reported herein must leave the reader with a dilemma, however. This dilemma concerns the choice of an exposure criterion for use by the military to adequately assess the risks of its field personnel and collaterally exposed civilians to mortality from the early marrow syndrome. According to Figure I-1, taken from the Reactor Safety Study report (1) and reproduced in the introduction of this report, the average marrow dose required to produce LD_{50} (50% mortality in man, death in 30-60 days) is 340 rads (marrow). This value has been obtained from cases of human exposure to photon radiation. Application of the average marrow dose/free-in-air conversion factors for the initial gamma radiation fields produced by typical modern weapons, as shown in Table IV-2, results in a required exposure of 472 rad (tis) free-in-air to produce the 340 rad (marrow) dose. The uncertainties in the marrow dose criterion and transport combined are approximately 11%, therefore within these limits of uncertainty the LD_{50} exposure criterion calculated for weapon gamma rays is in good agreement with the equivalent value most commonly cited in DoD reports (23), which is 450 rad (tis) FIA. Thus, for troops at the periphery of an initial radiation field produced by a weapon larger than about 100 kt, the current DoD criterion appears to be quite adquate.

The dilemma arises when a choice of an early mortality criterion must be made for the case of exposure to the mixed neutron-gamma radiation field typical of a low yield nuclear weapon. The level of exposure to weapon neutrons alone which is required to produce an LD_{50} marrow dose becomes 580 to 610 rad (tis) FIA, depending on weapon type and yield. Of course, these large exposure

requirements are valid only if it is true that the average marrow dose parameter is a valid number of merit in relation to such an effect and that the relative biological effectiveness (RBE) of neutron dose for this effect is unity, i.e., that neutrons and gamma rays are equally effective at producing the phenomena which in turn produce early mortality.

The extent to which the average marrow dose is a valid number of merit for the prediction of the effect of interest depends on the amount of dose nonuniformity already allowed for in obtaining the criterion value. Since this value was obtained for the case of pure gamma ray exposure this amount is quite small, with the minimum marrow dose probably being within 6% of the average. In the event of exposure to a mixed neutron-gamma ray field it is possible for the minimum marrow dose to be much less than 90% of the average value. In this case the average marrow dose is probably not a valid number of merit for the prediction of mortality from the acute marrow syndrome. A better number would be the minimum dose, since it applies to so much of the marrow. This conclusion is supported by the findings of Bond and Robinson (2) which are summarized as follows:

1. Survival in most mammals exposed to amounts of penetrating radiation in the hematological syndrome range depends primarily on maintenance of a critical level of neutrophils and platelets in the peripheral blood.

2. This minimum level depends on the survival (or proliferative integrity) of a critical number or fraction of the stem cells in the total marrow mass, regardless of distribution of surviving cells in that mass.

3. Each species of mammal has its own criterion for survival probability as a function of surviving stem cell number or fraction.

Using the minimum marrow dose as the number of merit in acute marrow syndrome mortality prediction changes the LD_{50} gamma ray exposure criterion very little; however, it increases that for the mixed

radiation fields of the modern weapons considered to between 650 and 700 rad (tis) FIA, depending on weapon type and size.

All exposure values for mixed radiation fields cited above were produced under the assumption of a neutron dose RBE of unity. However, most available evidence suggests that the neutron dose RBE for the acute marrow syndrome is greater than 1. Bond and Robinson (2) obtained a value of 1.4 in their canine experiments, though they admit that this is a rough estimate. Katz et al., have obtained information which suggests that the RBE for stem cell proliferative integrity, albeit in mice, lies in the range of 3 to 4. This range is applicable for neutron doses in excess of 100 rad (marrow) and neutron energies between .5 and 2 MeV. According to Katz, RBE values increase exponentially with decreasing marrow dose. On the basis of these pieces of evidence it seems reasonable to assume that, for the effect of interest, likely upper and lower bounds of the RBE value are 3.5 and 1.4, respectively. If this is indeed the case, then on the basis of <u>average marrow dose</u> the ranges of exposures necessary to produce 340 REM (marrow) are 300 to 330 rad (tis) FIA for the upper bound RBE value and 500 to 530 for the lower bound, depending on weapon type. On the basis of <u>minimum marrow dose</u>, as discussed previously, these dose ranges would be 360 to 410 for the upper bound RBE value and 575 to 625 for the lower bound. Again, applicable values within each range depend on weapon type and size. Lower dose values apply to enhanced radiation devices, while higher dose values apply to other weapon types and increase with weapon size.

It would seem that, on the basis of data reported herein and interpreted in the above discussion, one faces a considerable dilemma in choosing the correct mortality probability criterion for the case of exposure to a mixed neutron-gamma radiation field. According to present knowledge of the RBE for neutrons pertaining to the early

mortality effect, the criterion for LD_{50} equivalent exposure is most likely to be between 330 and 625 rad (tis) FIA for non-radiation enhanced tactical weapons and between 300 and 575 rad (tis) FIA for enhanced devices. Lesser lower bounds than those given above are conceivable, while it is unlikely that the criterion would approach, much less exceed, the given upper bound.

Research on radiation effects at the cellular level has progressed to the point at which it is possible to predict the probability of many such effects, including proliferative integrity, resulting from exposure to any incident radiation field, high LET, low LET or a mixture thereof. This is providing that the dose levels of interest are on the order of a rad or more. The adjoint Monte Carlo approach demonstrated here for the calculation of gross energy deposition in human marrow from incident neutron and gamma radiation may also be used to calculate the probability of such cellular effects in situ, providing the appropriate cellular response parameters are substituted for KERMA. The results of such a calculation for the probability of marrow cell proliferative integrity could be made relevant to the prediction of acute marrow syndrome mortality probability by calibration to available criteria based on pure photon exposure. Such a procedure would remove the need to consider appropriate dose values of merit or the RBE if high LET radiation, since all such consideration would be implicit in the cellular effect calculation. With these results in hand it would be possible to determine mortality probability criteria for whole body exposure to radiation of all weapon types as well as for scenarios which involve nonuniform shielding of the body, such as troops in foxholes, tank crews, etc. However, until such time as the cellular-effect based calculations are performed and appropriate acute marrow syndrome mortality probability criteria are established for mixed-LET radiation exposures, the nominal exposure criterion of 450 rad (tis) FIA for LD_{50} equivalence should be used with extreme caution.

For exposure to radiation fields from typical tactical nuclear weapons the 450 rad value is encompassed by an uncertainty range so large ($\sim\pm$ 33%) as to preclude its selection as the actual criterion from being other than fortuitous.

SECTION VI

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APPENDIX A

MATHEMATICAL DESCRIPTION OF THE REFERENCE MAN PHANTOM

The mathematical description of the external configuration of the reference man phantom and that of its internal organs is based on that published in, "A Tabulation of Dose Equivalent per Microcurie-Day for Source and Target Organs of an Adult for Various Radionuclides," ORNL-5000, W.S. Snyder, et. al., November 1974. The conversion of the Snyder descriptive equations into the combinatorial geometry format required by the MORSE Monte Carlo transport code required only a single modification. The Snyder phantom contains head, skull and lungs which are described in total or in part by ellipsoids. However, combinatorial geometry is limited to the description of prolate or oblate spheroids. Therefore, the ellipsoid-spheroid conversion was made when necessary, conserving volume and approximating the original configuration as closely as possible.

Exterior of the Phantom

The body is represented as erect with the positive z-axis directed upward toward the head. The x-axis is directed to the phantom's right and the y-axis is directed toward the anterior side of the phantom. The origin is taken at the center of the base of the "trunk" section of the phantom. The axes are calibrated in centimeters.

The "trunk" is a solid elliptical cylinder specified by

$$\left(\frac{x}{20}\right)^2+\left(\frac{y}{10}\right)^2 \leq 1, \quad 0 \leq z \leq 70$$

so that the "trunk" includes the arms as well as the pelvic and hip bones from the point where the separation of the legs begins. The volume of the trunk section is 43,982 cm^3, and the mass, as indicated below, is 42,701 g.

The head section is a right elliptical cylinder topped by half a prolate spheroid. The locus is specified by

$$\left(\frac{x}{7}\right)^2 + \left(\frac{y}{10}\right)^2 \leqq 1, \quad 70 \leqq z \leqq 85.5$$

or

$$\left(\frac{x}{7.713}\right)^2 + \left(\frac{y}{10}\right)^2 + \left(\frac{z-85.5}{7.713}\right)^2 \leqq 1, \quad 85.5 \leqq z \leqq 93.213$$

The total volume is 4,655 cm^3, and the mass, as indicated below, is 5,083 g.

The leg region of the phantom consists of the frustums of two circular cones specified by

$$x^2 + y^2 \leqq \pm x\left(20 + \frac{z}{5}\right), \quad -80 \leqq z \leqq 0,$$

where the plus sign defines the right leg and the minus sign the left. The total volume of both legs is 20,776 cm^3, and the mass, as discussed below, is 21,901 g. It is apparent that the leg region does not join smoothly to the trunk region, because the legs protrude slightly beyond the ellipse defining the trunk in the plane z = 0.

The genitalia region (male) of the phantom consists of the region specified by

$$-4.8 \leqq z \leqq 0 \quad -\left(10 + \frac{z}{10}\right) \leqq x \leqq 10 + \frac{z}{10}, \quad \left(10 + \frac{z}{10}\right) \geq y \geq 0,$$

and

$$\left(x \pm \left(10 + \frac{z}{10}\right)\right)^2 + y^2 \geqq \left(10 + \frac{z}{10}\right)^2,$$

and this last inequality must hold for either choice of sign, i.e., the

genitalia region lies outside both legs. The genitalia region has a volume of 196.3 cm^3 and a mass of 193.7 g.

Organs

Skeletal System. The skeletal system consists of the 8 parts described below. A view of the total skeleton is shown in Figure A-1.

Leg Bones. Each leg bone is the frustum of an elliptical cone. The expression for the right leg bone is

$$\left(x - 10 - \frac{8}{79.8} z\right)^2 + y^2 \leq \left(3.5 + \frac{2.5}{79.8} z\right)^2 , \quad -79.8 \leq z \leq 0.$$

The volume of both bones is 2,799 cm^3, and the mass is 4,160 g.

Arm Bones. Each arm bone is the frustum of an elliptical cone. The right one is defined by

$$\left[\frac{(1.4/138\ (z-69) + (x-18.4)}{1.4}\right]^2 + \left(\frac{y}{2.7}\right)^2 \leq \left[\frac{138 + (z-69)}{138}\right]^2 ,$$

$0 \leq z \leq 69.$

The volume of both arm bones is 956 cm^3 and the mass is 1,421 g.

Pelvis. The pelvis is a portion of the volume between two nonconcentric circular cylinders described by

$$x^2 + (y - 3)^2 \leq (12)^2$$

$$x^2 + (y - 3.8)^2 \geq (11.3)^2$$

$$y - 3 \leq 0$$

$$0 \leq z \leq 22$$

$$y \geq -5 \text{ if } z \leq 14.$$

Its volume is 606.1 cm^3 and its mass is 900.8 g.

Spine. The spine is an elliptical cylinder given by

$$\left(\frac{x}{2}\right)^2 + \left(\frac{y + 5.5}{2.5}\right)^2 \leq 1, \ 22 \leq z \leq 78.5,$$

and has a volume of 887.5 cm^3 and a mass of 1,319 g.

Skull. The skull is the volume between tow nonconcentric defined by

$$\left(\frac{x}{6.245}\right)^2 + \left(\frac{y}{9}\right)^2 + \left(\frac{z-86.5}{6.245}\right)^2 \geq 1$$

$$\left(\frac{x}{7.513}\right)^2 + \left(\frac{y}{9.8}\right)^2 + \left(\frac{z-85.5}{7.513}\right)^2 \leq 1$$

and has a volume of 846.8 cm^3 and a mass of 1,258g.

Rib Cage. The rib volume is a series of bands between two concentric, right-vertical, elliptical cylinders. This region is sliced by a series of equispaced horizontal planes into slabs, every other slice being a rib. The statements that must be satisfied are

$$\left(\frac{x}{17}\right)^2 + \left(\frac{y}{9.8}\right)^2 \leq 1$$

$$\left(\frac{x}{16.5}\right)^2 + \left(\frac{y}{9.3}\right)^2 \geq 1,$$

$$35.1 \leq z \leq 67.3;$$

$$\text{Integer } \frac{z-35.1}{1.4} \text{ is even}$$

Integer (u) is the integral part of u, i.e., integer (3.67) = 3, etc. Thus, "integer (z-35.1)/1.4 is even" amounts to requiring that

$$0 \leq \frac{z-35.1}{1.4} < 1 \text{ or } 2 \leq \frac{z-35.1}{1.4} < 3 \text{ or } 4 \leq \frac{z-35.1}{1.4} < 5, \text{ etc.}$$

The total rib volume is 694 cm^3 and the mass is 1,031 g.

Clavicles. The clavicles are represented as two portions of an annular region between two concentric right-vertical elliptical cylinders. The statements which must be satisfied are

$$\left(\frac{x}{20.7}\right)^2 + \left(\frac{y+11.1}{20.7}\right)^2 \leq 1$$

$$\left(\frac{x}{19.3}\right)^2 + \left(\frac{y+11.1}{19.3}\right)^2 \geqq 1$$

$$10 > |x| > 1.4076$$

$$y > 0$$

$$68.95 \geqq z \geqq 67.55$$

The volume of both clavicles is approximately 54.7 cm^3, and the mass is approximately 82 g.

Scapulae. The scapulae extend from z = 5.09 to z = 67.3. The latter value corresponds to the top of the rib cage rather than the top of the 12th rib (z = 64.5 cm) as in the Snyder prescription. This variation was inadvertent but should have no material effect on the calculational results. The scapulae lie between two elliptical cylinders.

$$\left(\frac{x}{17}\right)^2 + \left(\frac{y}{9.8}\right)^2 = 1 \text{ (outer surface of ribs)}$$

and

$$\left(\frac{x}{19}\right)^2 + \left(\frac{y}{9.8}\right)^2 = 1 \text{ (a somewhat larger cylinder).}$$

Although the lower portion of the scapula is somewhat smaller than the upper, this distinction is ignored here, as in the Snyder model. Thus, the scapulae occupy all the above space between the planes

$$|x| \geqq 10.2956$$

$$y \leqq -4.2744$$

In Fig. A-1, a human adult skeleton has been sketched, and the areas which contain active bone marrow (red bone marrow) are cross-hatched. The idealized skeleton used for the phantom is sketched also with the corresponding areas cross-hatched. The red, or active, bone marrow is taken to total 1,500 g, and the same weight is assigned to yellow bone marrow. The weights of the two marrow types are given in Table A-1, and they are assigned to the corresponding regions of bone and are assumed to be uniformly distributed in these regions.

Lungs. Each lung is half a prolate spheroid with an anterior section removed. The defining expressions for the left lung are

$$\left(\frac{x - 8.5}{6.25}\right) + \left(\frac{y}{6.25}\right) + \left(\frac{z - 43.5}{24}\right) \leq 1,$$

$$z \geq 43.5,$$

$$\left(\frac{x - 1.8769}{6.25}\right) + \left(\frac{y}{6.25}\right) + \left(\frac{z - 43.5}{24}\right) \geq 1 \quad \text{if } y > 0.$$

The volume of both lungs is 3,378 cm^3 and the mass is 999.2 g.

Table A-1 Masses of Red and Yellow Marrow and Bone in the Phantom

Bone Region	Red Marrow (g)	Bone (g)	Yellow Marrow (g)
Arms			
Upper*	28.5	474	9.5
Lower	0	520	389
Clavicles	24	49.2	8
Legs			
Upper**	57	2 036	19
Lower	0	1 588	461
Pelvis	543	177	181
Ribs	153	677	201
Scapulae	72	206	24
Skull			
Cranium***	178.5	557	59.5
Mandible†	18	439	6
Spine	426	750.8	142
TOTAL	1 500	7 474	1 500

*$69 \geq z \geq 52.6$ **$0 \geq z \geq -22.8$ ***$z \geq 3y + 77$

†$y \geq 0$, $77.99 \leq z \leq 80.26$

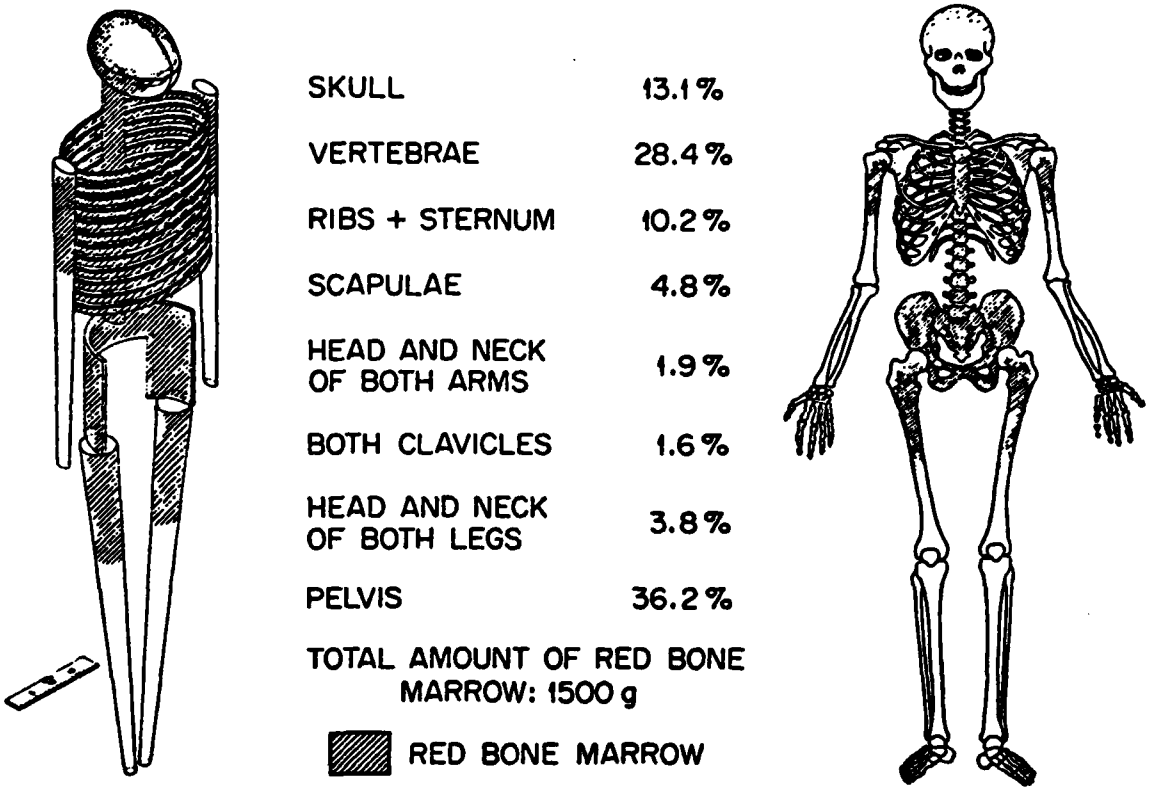


Fig. A-1. Idealized model of the skeleton for computer calculations (left) and a more realistic representation (right) with percentages of red bone marrow found in the shaded portions of the bones. Clavicles and scapulae not shown in phantom.

APPENDIX B
ANGLE-INTEGRATED DOSE DEPOSITION FACTORS

This appendix contains tabulated active marrow dose deposition factors for 4π angle-integrated incident fluence in 37 neutron and 21 gamma ray energy groups. Table II-2, which gives the energy boundaries for these groups, is reproduced here for the reader's convenience. Tabulated dose deposition factors are presented for eight skeletal regions and for reference man. The reference man values have been obtained by weighting the skeletal region responses by their respective marrow fractions and taking the sum for all eight regions. Tabulated quantities include neutron (n-n), gamma ray (n-γ) and total (n-t) dose deposition per unit incident neutron fluence and gamma ray dose (γ-γ) per unit incident gamma ray fluence. Note that use of the dose deposition factors contained in this appendix implies the assumption of isotropic incident fluence.

Table II-2 NEUTRON AND GAMMA-RAY ENERGY BOUNDARIES FOR THE 37-21 COUPLED NEUTRON-GAMMA LIBRARY

Group No.	Neutron Group (eV)		Gamma Group (eV)	
	Energy	Lethargy	Energy	Eff. Avg.
1	1.96+7*	-0.675	1.40+7	1.20+7
2	1.69+7	-0.525	1.00+7	9.00+6
3	1.49+7	-0.400	8.00+6	7.50+6
4	1.42+7	-0.350	7.00+6	6.50+6
5	1.38+7	-0.325	6.00+6	5.50+6
6	1.28+7	-0.250	5.00+6	4.50+6
7	1.22+7	-0.200	4.00+6	3.50+6
8	1.11+7	-0.100	3.00+6	2.75+6
9	1.00+7	0.000	2.50+6	2.25+6
10	9.05+6	0.100	2.00+6	1.75+6
11	8.19+6	0.200	1.50+6	1.25+6
12	7.41+6	0.300	1.00+6	8.50+5
13	6.38+6	0.450	7.00+5	5.75+5
14	4.97+6	0.700	4.50+5	3.75+5
15	4.72+6	0.750	3.00+5	2.25+5
16	4.07+6	0.900	1.50+5	1.25+5
17	3.01+6	1.200	1.00+5	8.50+4
18	2.39+6	1.433	7.00+4	5.75+4
19	2.31+6	1.467	4.50+4	3.75+4
20	1.83+6	1.700	3.00+4	2.50+4
21	1.11+6	2.200	2.00+4	1.50+4
22	5.50+5	2.900	1.00+4	
23	1.58+5	4.150		
24	1.11+5	4.500		
25	5.25+4	5.250		
26	2.48+4	6.000		
27	2.19+4	6.125		
28	1.03+4	6.875		
29	3.35+3	8.000		
30	1.23+3	9.000		
31	5.83+2	9.750		
32	1.01+2	11.500		
33	2.90+1	12.750		
34	1.07+1	13.750		
35	3.06+0	15.000		
36	1.13+0	16.000		
37	4.14-1	17.000		
38	1.00-5	27.631		

*Read as 1.96×10^7.

ANGLE-INTEGRATED DOSE DEPOSITION FACTORS

Neutron Dose Deposition From Incident Neutron Fluence

(rad (marrow) per unit fluence per energy group)

GROUP **	PELVIS * .362	FSD	SPINE .284	FSD	SKULL .131	FSD
1	4.732E-09	.035	4.637E-09	.035	5.722E-09	.031
2	4.200E-09	.036	4.647E-09	.032	5.824E-09	.032
3	3.846E-09	.035	3.950E-09	.039	5.166E-09	.032
4	3.954E-09	.038	4.188E-09	.037	5.032E-09	.035
5	3.996E-09	.037	3.971E-09	.038	4.869E-09	.034
6	4.061E-09	.037	4.173E-09	.042	4.851E-09	.035
7	3.996E-09	.041	3.557E-09	.044	4.721E-09	.035
8	3.231E-09	.047	3.614E-09	.042	4.352E-09	.039
9	3.200E-09	.047	3.499E-09	.046	4.389E-09	.039
10	2.903E-09	.050	3.052E-09	.049	4.173E-09	.039
11	2.835E-09	.050	2.837E-09	.050	3.844E-09	.041
12	2.662E-09	.058	2.885E-09	.057	3.517E-09	.045
13	2.370E-09	.063	2.226E-09	.060	3.641E-09	.046
14	2.195E-09	.058	2.018E-09	.066	2.985E-09	.048
15	1.817E-09	.067	2.103E-09	.068	3.213E-09	.048
16	1.296E-09	.087	1.391E-09	.091	2.693E-09	.054
17	1.172E-09	.083	1.044E-09	.090	1.969E-09	.064
18	1.107E-09	.084	9.842E-10	.098	1.963E-09	.063
19	7.675E-10	.115	1.062E-09	.115	2.050E-09	.074
20	7.607E-10	.127	6.774E-10	.127	1.466E-09	.072
21	2.608E-10	.167	3.041E-10	.154	1.028E-09	.088
22	5.092E-11	.246	1.101E-10	.183	4.593E-10	.088
23	5.056E-11	.320	3.863E-11	.273	2.132E-10	.088
24	2.163E-11	.341	3.263E-11	.450	1.160E-10	.119
25	2.946E-11	.566	2.664E-11	.440	7.000E-11	.137
26	4.225E-12	.477	1.081E-11	.558	4.740E-11	.135
27	2.449E-11	.932	1.256E-11	.614	4.452E-11	.274
28	1.926E-11	.876	4.758E-12	.787	1.165E-11	.198
29	7.320E-12	.696	6.589E-12	.687	2.654E-11	.396
30	3.601E-11	.611	1.520E-11	.451	1.023E-11	.571
31	1.841E-11	.538	1.104E-11	.470	1.469E-11	.503
32	2.409E-11	.408	3.125E-12	.883	1.316E-11	.450
33	1.431E-11	.578	6.624E-12	1.000	1.565E-11	.452
34	1.509E-11	.510	4.026E-12	1.000	1.559E-11	.472
35	2.450E-12	1.000	3.224E-12	1.000	1.588E-11	.496
36	1.017E-11	.705	1.018E-11	.705	3.054E-13	.705
37	2.728E-12	.166	5.382E-12	.126	9.984E-12	.085

GROUP **	RIBS * .102	FSD	SCAPULAE .048	FSD	LEGS .038	FSD
1	5.243E-09	.034	5.802E-09	.033	4.918E-09	.032
2	5.301E-09	.032	5.219E-09	.034	4.720E-09	.033
3	4.892E-09	.037	4.985E-09	.032	4.395E-09	.035
4	4.918E-09	.038	4.880E-09	.033	4.333E-09	.036
5	4.440E-09	.035	4.730E-09	.033	4.160E-09	.038
6	4.369E-09	.039	4.509E-09	.037	3.754E-09	.037
7	4.448E-09	.037	4.249E-09	.038	3.659E-09	.041
8	4.515E-09	.038	4.451E-09	.037	3.490E-09	.040
9	3.905E-09	.044	4.080E-09	.038	3.369E-09	.046
10	3.957E-09	.041	3.755E-09	.044	3.219E-09	.050
11	3.516E-09	.047	4.142E-09	.041	2.993E-09	.052
12	3.356E-09	.049	3.639E-09	.048	3.060E-09	.061
13	2.970E-09	.055	3.090E-09	.051	2.405E-09	.066
14	2.917E-09	.054	2.640E-09	.053	2.035E-09	.063
15	2.628E-09	.059	2.886E-09	.055	1.695E-09	.071
16	2.304E-09	.062	2.651E-09	.052	1.492E-09	.073
17	1.877E-09	.071	1.926E-09	.061	1.235E-09	.082
18	1.857E-09	.069	1.872E-09	.069	1.180E-09	.089
19	1.568E-09	.078	1.798E-09	.066	1.080E-09	.098
20	1.245E-09	.083	1.395E-09	.077	5.968E-10	.129
21	7.270E-10	.101	8.477E-10	.105	2.121E-10	.167
22	4.292E-10	.087	4.643E-10	.085	4.539E-11	.282
23	2.125E-10	.093	2.356E-10	.091	1.144E-11	.285
24	1.344E-10	.113	1.304E-10	.110	8.613E-12	.546
25	7.675E-11	.174	7.761E-11	.182	8.443E-12	.417
26	5.271E-11	.240	4.531E-11	.208	4.158E-11	.615
27	2.645E-11	.330	3.154E-11	.200	6.096E-12	.691
28	1.206E-11	.191	1.412E-11	.215	1.487E-11	.584
29	1.559E-11	.406	2.471E-11	.713	1.348E-11	.781
30	1.594E-11	.422	7.957E-12	.612	4.582E-12	.695
31	1.903E-11	.532	2.062E-11	.438	8.189E-12	.571
32	1.477E-11	.534	1.330E-11	.480	1.065E-11	.585
33	1.963E-11	.437	2.532E-11	.396	1.226E-11	.576
34	2.063E-11	.494	9.001E-12	.612	1.438E-11	.579
35	2.673E-11	.370	9.058E-12	.636	1.120E-11	.577
36	3.471E-11	.363	1.514E-11	.495	0.	0.000
37	1.302E-11	.074	1.490E-11	.078	2.805E-12	.167

GROUP	ARMS	FSD	CLAVICLES	FSD	WEIGHTED RESPONSE	FSD
**	.019		.016			
1	5.972E-09	.033	5.339E-09	.031	4.979E-09	.034
2	5.518E-09	.032	5.390E-09	.034	4.765E-09	.033
3	4.725E-09	.035	5.002E-09	.035	4.266E-09	.036
4	4.950E-09	.032	4.892E-09	.033	4.353E-09	.037
5	4.916E-09	.040	4.718E-09	.038	4.219E-09	.036
6	4.769E-09	.037	4.657E-09	.039	4.261E-09	.038
7	4.658E-09	.039	4.499E-09	.036	4.032E-09	.040
8	4.323E-09	.040	4.022E-09	.043	3.719E-09	.043
9	4.396E-09	.041	3.792E-09	.042	3.593E-09	.044
10	4.205E-09	.040	3.689E-09	.042	3.310E-09	.046
11	3.975E-09	.039	4.054E-09	.044	3.147E-09	.047
12	3.305E-09	.045	3.551E-09	.049	2.997E-09	.054
13	3.586E-09	.045	3.387E-09	.051	2.632E-09	.057
14	3.293E-09	.047	3.204E-09	.046	2.374E-09	.057
15	3.069E-09	.055	2.978E-09	.053	2.253E-09	.061
16	2.519E-09	.061	2.503E-09	.056	1.724E-09	.074
17	2.026E-09	.061	2.066E-09	.066	1.381E-09	.077
18	2.040E-09	.061	1.786E-09	.065	1.329E-09	.079
19	1.877E-09	.067	1.415E-09	.080	1.194E-09	.094
20	1.524E-09	.094	1.532E-09	.071	9.298E-10	.104
21	8.838E-10	.111	8.664E-10	.093	4.690E-10	.122
22	4.697E-10	.092	3.711E-10	.094	1.925E-10	.120
23	1.971E-10	.083	1.955E-10	.098	9.749E-11	.155
24	1.370E-10	.116	1.200E-10	.136	5.710E-11	.204
25	6.350E-11	.154	6.230E-11	.155	4.148E-11	.317
26	4.702E-11	.256	3.510E-11	.169	2.140E-11	.295
27	2.943E-11	.229	3.262E-11	.225	2.379E-11	.573
28	2.137E-11	.484	1.567E-11	.453	1.298E-11	.655
29	1.022E-11	.485	2.256E-11	.442	1.184E-11	.562
30	8.568E-12	.516	1.286E-11	.642	2.124E-11	.562
31	2.726E-11	.409	1.034E-11	.621	1.565E-11	.510
32	1.476E-11	.439	1.768E-11	.368	1.445E-11	.463
33	1.654E-11	.427	3.015E-11	.361	1.359E-11	.569
34	6.971E-12	.682	3.001E-11	.398	1.234E-11	.551
35	1.397E-11	.500	8.316E-12	.662	7.868E-12	.583
36	2.198E-11	.442	1.615E-11	.552	1.155E-11	.574
37	1.288E-11	.075	1.365E-11	.084	6.437E-12	.105

* REGION

** REGION ACTIVE MARROW FRACTION

ANGLE-INTEGRATED DOSE DEPOSITION FACTORS

Gamma Ray Dose Deposition From Incident Neutron Fluence

(rad (marrow) per unit fluence per energy group)

GROUP **	PELVIS * .362	FSD	SPINE .284	FSD	SKULL .131	FSD
1	2.095E-10	.086	2.383E-10	.081	8.896E-11	.151
2	2.224E-10	.083	1.951E-10	.089	1.414E-10	.107
3	2.312E-10	.089	2.951E-10	.081	1.599E-10	.111
4	2.927E-10	.080	2.285E-10	.085	1.174E-10	.111
5	2.640E-10	.086	2.726E-10	.084	1.528E-10	.120
6	2.825E-10	.080	2.026E-10	.091	1.181E-10	.113
7	2.617E-10	.089	2.681E-10	.089	1.530E-10	.108
8	2.610E-10	.090	2.527E-10	.094	1.594E-10	.124
9	2.431E-10	.097	2.209E-10	.102	1.302E-10	.143
10	2.321E-10	.096	2.364E-10	.100	1.058E-10	.156
11	2.172E-10	.134	1.928E-10	.116	9.391E-11	.160
12	1.772E-10	.124	1.727E-10	.126	6.563E-11	.207
13	1.715E-10	.150	1.361E-10	.128	7.879E-11	.198
14	2.061E-10	.156	1.593E-10	.155	5.713E-11	.232
15	1.694E-10	.138	1.596E-10	.151	5.954E-11	.205
16	1.825E-10	.147	1.583E-10	.158	9.712E-11	.244
17	1.989E-10	.128	1.364E-10	.123	9.349E-11	.198
18	1.837E-10	.134	2.015E-10	.140	6.276E-11	.236
19	1.767E-10	.152	1.809E-10	.142	9.201E-11	.193
20	2.076E-10	.153	1.630E-10	.137	8.550E-11	.214
21	1.872E-10	.132	1.928E-10	.131	8.677E-11	.213
22	1.412E-10	.126	1.755E-10	.119	1.037E-10	.215
23	1.286E-10	.142	1.649E-10	.132	8.677E-11	.239
24	1.351E-10	.139	1.887E-10	.136	9.882E-11	.184
25	1.446E-10	.154	1.625E-10	.184	8.393E-11	.206
26	1.241E-10	.194	1.568E-10	.172	1.100E-10	.216
27	1.447E-10	.174	1.425E-10	.194	1.261E-10	.192
28	1.213E-10	.238	1.365E-10	.177	9.739E-11	.216
29	1.582E-10	.151	1.573E-10	.151	1.190E-10	.170
30	1.396E-10	.166	1.598E-10	.178	9.625E-11	.201
31	1.226E-10	.180	1.644E-10	.182	7.425E-11	.233
32	1.554E-10	.197	1.415E-10	.183	6.252E-11	.236
33	1.574E-10	.227	1.714E-10	.159	1.081E-10	.243
34	1.378E-10	.258	1.296E-10	.200	1.373E-10	.244
35	1.714E-10	.322	1.457E-10	.236	1.113E-10	.216
36	1.143E-10	.349	1.068E-10	.327	8.817E-11	.422
37	5.064E-11	.130	6.399E-11	.105	5.718E-11	.123

GROUP	RIBS *	FSD	SCAPULAE	FSD	LEGS	FSD
**	.102		.048		.038	
1	1.690E-10	.110	1.410E-10	.121	1.691E-10	.107
2	1.892E-10	.099	1.496E-10	.122	2.202E-10	.089
3	1.737E-10	.098	2.204E-10	.099	2.310E-10	.086
4	1.950E-10	.097	1.565E-10	.099	2.184E-10	.094
5	1.598E-10	.107	1.736E-10	.104	2.254E-10	.094
6	1.745E-10	.102	1.716E-10	.093	2.254E-10	.093
7	2.127E-10	.100	1.387E-10	.107	2.508E-10	.093
8	1.875E-10	.109	1.646E-10	.120	2.503E-10	.096
9	1.690E-10	.107	1.403E-10	.137	1.934E-10	.096
10	1.481E-10	.128	1.320E-10	.135	1.836E-10	.108
11	1.286E-10	.137	1.198E-10	.132	1.854E-10	.115
12	1.435E-10	.156	7.191E-11	.190	1.435E-10	.132
13	9.825E-11	.214	8.323E-11	.187	1.428E-10	.158
14	1.167E-10	.175	7.698E-11	.187	1.295E-10	.151
15	1.283E-10	.159	1.055E-10	.178	1.018E-10	.164
16	1.100E-10	.178	8.540E-11	.192	1.373E-10	.167
17	1.183E-10	.161	7.416E-11	.174	2.070E-10	.135
18	1.261E-10	.179	1.084E-10	.176	1.837E-10	.135
19	1.461E-10	.148	7.091E-11	.207	1.581E-10	.136
20	1.266E-10	.160	1.028E-10	.221	1.471E-10	.157
21	1.483E-10	.148	1.045E-10	.167	1.367E-10	.144
22	1.472E-10	.152	9.998E-11	.158	1.450E-10	.160
23	1.196E-10	.162	9.563E-11	.171	1.502E-10	.139
24	1.074E-10	.178	8.594E-11	.206	1.483E-10	.146
25	1.256E-10	.191	6.582E-11	.232	1.248E-10	.150
26	9.113E-11	.193	8.538E-11	.215	1.340E-10	.166
27	1.291E-10	.206	1.114E-10	.238	1.493E-10	.186
28	1.202E-10	.188	8.207E-11	.249	1.504E-10	.174
29	1.451E-10	.155	1.263E-10	.175	1.624E-10	.135
30	1.515E-10	.200	9.118E-11	.212	1.679E-10	.184
31	1.784E-10	.222	9.999E-11	.186	1.515E-10	.158
32	1.714E-10	.177	1.485E-10	.212	1.406E-10	.155
33	1.776E-10	.182	7.877E-11	.209	1.368E-10	.183
34	2.115E-10	.255	1.245E-10	.202	1.224E-10	.235
35	1.691E-10	.186	1.956E-10	.270	8.001E-11	.240
36	1.068E-10	.308	1.323E-10	.381	1.098E-10	.295
37	6.883E-11	.112	5.887E-11	.111	6.277E-11	.114

GROUP	ARMS	FSD	CLAVICLES	FSD	WEIGHTED RESPONSE	FSD
**	.019		.016			
1	1.160E-10	.111	1.376E-10	.115	1.900E-10	.092
2	1.154E-10	.116	1.657E-10	.107	1.941E-10	.091
3	1.492E-10	.116	1.877E-10	.106	2.313E-10	.090
4	1.489E-10	.104	1.480E-10	.112	2.271E-10	.087
5	1.188E-10	.121	1.632E-10	.096	2.311E-10	.091
6	1.254E-10	.122	1.493E-10	.112	2.146E-10	.089
7	1.399E-10	.107	1.693E-10	.112	2.342E-10	.093
8	1.379E-10	.134	1.448E-10	.146	2.286E-10	.099
9	1.314E-10	.126	1.335E-10	.124	2.038E-10	.105
10	1.161E-10	.134	1.267E-10	.133	1.977E-10	.106
11	1.055E-10	.156	1.107E-10	.150	1.754E-10	.130
12	4.534E-11	.216	9.418E-11	.161	1.477E-10	.136
13	3.939E-11	.257	6.400E-11	.217	1.323E-10	.155
14	6.530E-11	.224	6.901E-11	.179	1.502E-10	.162
15	4.099E-11	.252	6.742E-11	.221	1.383E-10	.152
16	4.792E-11	.230	8.065E-11	.186	1.465E-10	.164
17	5.480E-11	.218	7.967E-11	.175	1.488E-10	.138
18	8.713E-11	.216	5.503E-11	.228	1.595E-10	.148
19	6.029E-11	.249	8.861E-11	.201	1.543E-10	.154
20	5.106E-11	.245	7.000E-11	.194	1.582E-10	.156
21	6.473E-11	.212	1.266E-10	.170	1.625E-10	.141
22	7.533E-11	.187	9.947E-11	.186	1.429E-10	.138
23	5.831E-11	.210	8.613E-11	.199	1.297E-10	.151
24	5.379E-11	.271	1.389E-10	.192	1.394E-10	.149
25	6.114E-11	.210	1.080E-10	.195	1.331E-10	.175
26	6.735E-11	.255	8.076E-11	.225	1.249E-10	.189
27	6.799E-11	.244	9.225E-11	.247	1.363E-10	.189
28	5.039E-11	.272	1.176E-10	.198	1.202E-10	.208
29	6.104E-11	.239	1.067E-10	.175	1.474E-10	.155
30	5.082E-11	.262	9.327E-11	.189	1.372E-10	.180
31	7.608E-11	.262	9.786E-11	.195	1.326E-10	.191
32	9.366E-11	.188	1.380E-10	.184	1.386E-10	.192
33	9.848E-11	.236	1.283E-10	.199	1.509E-10	.199
34	8.656E-11	.241	1.355E-10	.229	1.407E-10	.237
35	1.079E-10	.277	1.254E-10	.244	1.517E-10	.267
36	1.038E-10	.330	3.103E-10	.313	1.116E-10	.344
37	5.703E-11	.103	8.229E-11	.099	5.863E-11	.117

* REGION

** REGION ACTIVE MARROW FRACTION

ANGLE-INTEGRATED DOSE DEPOSITION FACTORS

Total Dose (n+γ) From Incident Neutron Fluence

(rad (marrow) per unit fluence per energy group)

GROUP	PELVIS *	SPINE	SKULL
**	.362	.284	.131
1	4.942E-09	4.875E-09	5.811E-09
2	4.422E-09	4.842E-09	5.965E-09
3	4.077E-09	4.245E-09	5.326E-09
4	4.247E-09	4.417E-09	5.149E-09
5	4.260E-09	4.244E-09	5.022E-09
6	4.344E-09	4.376E-09	4.970E-09
7	4.257E-09	3.825E-09	4.874E-09
8	3.492E-09	3.866E-09	4.511E-09
9	3.443E-09	3.720E-09	4.519E-09
10	3.135E-09	3.289E-09	4.279E-09
11	3.052E-09	3.030E-09	3.938E-09
12	2.839E-09	3.058E-09	3.583E-09
13	2.541E-09	2.362E-09	3.720E-09
14	2.401E-09	2.177E-09	3.042E-09
15	1.987E-09	2.263E-09	3.273E-09
16	1.478E-09	1.549E-09	2.790E-09
17	1.371E-09	1.180E-09	2.062E-09
18	1.290E-09	1.186E-09	2.025E-09
19	9.441E-10	1.243E-09	2.142E-09
20	9.683E-10	8.404E-10	1.551E-09
21	4.480E-10	4.969E-10	1.115E-09
22	1.922E-10	2.856E-10	5.630E-10
23	1.791E-10	2.035E-10	2.999E-10
24	1.567E-10	2.213E-10	2.148E-10
25	1.741E-10	1.891E-10	1.539E-10
26	1.283E-10	1.676E-10	1.574E-10
27	1.692E-10	1.550E-10	1.706E-10
28	1.405E-10	1.413E-10	1.090E-10
29	1.655E-10	1.639E-10	1.455E-10
30	1.756E-10	1.749E-10	1.065E-10
31	1.410E-10	1.754E-10	8.894E-11
32	1.795E-10	1.446E-10	7.569E-11
33	1.717E-10	1.781E-10	1.238E-10
34	1.529E-10	1.336E-10	1.529E-10
35	1.738E-10	1.490E-10	1.271E-10
36	1.245E-10	1.170E-10	8.848E-11
37	5.337E-11	6.937E-11	6.716E-11

GROUP **	RIBS * .102	SCAPULAE .048	LEGS .038
1	5.412E-09	5.943E-09	5.087E-09
2	5.491E-09	5.369E-09	4.940E-09
3	5.065E-09	5.205E-09	4.626E-09
4	5.113E-09	5.036E-09	4.551E-09
5	4.599E-09	4.904E-09	4.386E-09
6	4.544E-09	4.681E-09	3.979E-09
7	4.661E-09	4.387E-09	3.909E-09
8	4.702E-09	4.615E-09	3.740E-09
9	4.074E-09	4.220E-09	3.562E-09
10	4.105E-09	3.887E-09	3.403E-09
11	3.645E-09	4.262E-09	3.178E-09
12	3.500E-09	3.711E-09	3.203E-09
13	3.069E-09	3.173E-09	2.548E-09
14	3.034E-09	2.717E-09	2.165E-09
15	2.756E-09	2.992E-09	1.796E-09
16	2.414E-09	2.736E-09	1.630E-09
17	1.996E-09	2.000E-09	1.442E-09
18	1.983E-09	1.980E-09	1.364E-09
19	1.714E-09	1.869E-09	1.238E-09
20	1.371E-09	1.498E-09	7.439E-10
21	8.752E-10	9.521E-10	3.488E-10
22	5.764E-10	5.643E-10	1.904E-10
23	3.321E-10	3.312E-10	1.616E-10
24	2.418E-10	2.163E-10	1.570E-10
25	2.023E-10	1.434E-10	1.332E-10
26	1.438E-10	1.307E-10	1.756E-10
27	1.556E-10	1.430E-10	1.554E-10
28	1.323E-10	9.619E-11	1.653E-10
29	1.607E-10	1.510E-10	1.759E-10
30	1.674E-10	9.914E-11	1.725E-10
31	1.974E-10	1.206E-10	1.597E-10
32	1.862E-10	1.618E-10	1.512E-10
33	1.973E-10	1.041E-10	1.491E-10
34	2.321E-10	1.335E-10	1.368E-10
35	1.958E-10	2.046E-10	9.121E-11
36	1.415E-10	1.474E-10	1.098E-10
37	8.185E-11	7.377E-11	6.558E-11

GROUP	ARMS *	CLAVICLES	WEIGHTED RESPONSE
**	.019	.016	
1	6.088E-09	5.477E-09	5.169E-09
2	5.634E-09	5.556E-09	4.959E-09
3	4.874E-09	5.189E-09	4.497E-09
4	5.099E-09	5.040E-09	4.580E-09
5	5.035E-09	4.881E-09	4.450E-09
6	4.894E-09	4.806E-09	4.475E-09
7	4.798E-09	4.668E-09	4.266E-09
8	4.460E-09	4.167E-09	3.948E-09
9	4.527E-09	3.925E-09	3.797E-09
10	4.321E-09	3.816E-09	3.507E-09
11	4.081E-09	4.165E-09	3.322E-09
12	3.350E-09	3.646E-09	3.144E-09
13	3.626E-09	3.451E-09	2.764E-09
14	3.358E-09	3.273E-09	2.524E-09
15	3.110E-09	3.045E-09	2.392E-09
16	2.567E-09	2.584E-09	1.870E-09
17	2.080E-09	2.146E-09	1.530E-09
18	2.127E-09	1.841E-09	1.488E-09
19	1.937E-09	1.504E-09	1.348E-09
20	1.575E-09	1.602E-09	1.088E-09
21	9.486E-10	9.930E-10	6.314E-10
22	5.451E-10	4.705E-10	3.354E-10
23	2.554E-10	2.816E-10	2.272E-10
24	1.908E-10	2.589E-10	1.965E-10
25	1.246E-10	1.703E-10	1.746E-10
26	1.144E-10	1.159E-10	1.463E-10
27	9.743E-11	1.249E-10	1.601E-10
28	7.177E-11	1.333E-10	1.332E-10
29	7.126E-11	1.292E-10	1.593E-10
30	5.939E-11	1.061E-10	1.584E-10
31	1.033E-10	1.082E-10	1.482E-10
32	1.084E-10	1.557E-10	1.530E-10
33	1.150E-10	1.584E-10	1.644E-10
34	9.353E-11	1.655E-10	1.530E-10
35	1.218E-10	1.337E-10	1.596E-10
36	1.258E-10	3.265E-10	1.232E-10
37	6.991E-11	9.594E-11	6.506E-11

* REGION

** REGION ACTIVE MARROW FRACTION

ANGLE-INTEGRATED DOSE DEPOSITION FACTORS

Gamma Ray Dose Deposition From Incident Gamma Ray Fluence

(rad (marrow) per unit fluence per energy group)

GROUP **	PELVIS * .362	FSD	SPINE .284	FSD	SKULL .131	FSD
1	2.382E-09	.027	2.341E-09	.027	2.605E-09	.026
2	1.754E-09	.030	1.866E-09	.031	2.043E-09	.032
3	1.516E-09	.033	1.513E-09	.031	1.771E-09	.033
4	1.310E-09	.038	1.350E-09	.035	1.532E-09	.036
5	1.276E-09	.037	1.286E-09	.036	1.391E-09	.035
6	1.129E-09	.038	1.045E-09	.040	1.144E-09	.041
7	8.561E-10	.049	9.048E-10	.042	9.814E-10	.045
8	7.033E-10	.051	7.256E-10	.052	7.765E-10	.044
9	5.889E-10	.041	6.160E-10	.036	7.205E-10	.038
10	4.984E-10	.041	4.808E-10	.045	5.624E-10	.041
11	3.755E-10	.048	3.740E-10	.050	4.695E-10	.042
12	2.573E-10	.042	2.492E-10	.041	3.128E-10	.035
13	1.823E-10	.048	1.768E-10	.049	2.246E-10	.039
14	1.125E-10	.055	1.134E-10	.045	1.497E-10	.039
15	6.465E-11	.058	6.272E-11	.051	8.512E-11	.041
16	3.823E-11	.045	3.558E-11	.049	4.840E-11	.042
17	3.148E-11	.054	2.780E-11	.059	3.690E-11	.048
18	2.342E-11	.060	2.136E-11	.064	3.538E-11	.050
19	1.465E-11	.072	1.215E-11	.078	3.392E-11	.049
20	2.870E-12	.287	3.344E-12	.281	2.744E-11	.112
21	0.	0.000	0.	0.000	2.005E-11	.307

GROUP	RIBS *	FSD	SCAPULAE	FSD	LEGS	FSD
**	.102		.048		.038	
1	2.462E-09	.028	2.589E-09	.026	2.320E-09	.028
2	2.005E-09	.030	1.943E-09	.033	1.820E-09	.034
3	1.635E-09	.035	1.720E-09	.032	1.613E-09	.035
4	1.441E-09	.033	1.476E-09	.039	1.387E-09	.037
5	1.320E-09	.034	1.408E-09	.037	1.267E-09	.041
6	1.206E-09	.040	1.088E-09	.043	1.007E-09	.042
7	9.389E-10	.043	8.990E-10	.042	8.575E-10	.047
8	7.672E-10	.048	7.950E-10	.049	7.126E-10	.044
9	6.958E-10	.036	6.754E-10	.035	6.231E-10	.035
10	5.694E-10	.039	5.631E-10	.043	5.020E-10	.043
11	3.944E-10	.048	4.444E-10	.044	3.430E-10	.050
12	3.197E-10	.035	3.327E-10	.037	2.604E-10	.036
13	2.160E-10	.043	2.253E-10	.038	1.894E-10	.047
14	1.352E-10	.039	1.458E-10	.045	1.173E-10	.057
15	8.232E-11	.051	8.039E-11	.046	6.693E-11	.053
16	4.924E-11	.041	4.570E-11	.047	3.827E-11	.049
17	3.706E-11	.053	3.597E-11	.049	2.848E-11	.057
18	3.251E-11	.055	3.278E-11	.053	2.457E-11	.060
19	3.760E-11	.049	3.770E-11	.046	1.369E-11	.074
20	3.678E-11	.095	3.200E-11	.110	4.684E-12	.233
21	8.801E-12	.473	2.286E-11	.285	0.	0.000

GROUP	ARMS	FSD	CLAVICLES	FSD	WEIGHTED RESPONSE	FSD
**	.019		.016			
1	2.489E-09	.027	2.575E-09	.025	2.420E-09	.027
2	2.093E-09	.030	2.020E-09	.029	1.872E-09	.031
3	1.758E-09	.033	1.607E-09	.035	1.580E-09	.033
4	1.570E-09	.038	1.577E-09	.034	1.384E-09	.036
5	1.299E-09	.035	1.369E-09	.036	1.306E-09	.036
6	1.129E-09	.038	1.224E-09	.041	1.110E-09	.040
7	9.379E-10	.045	9.785E-10	.045	9.004E-10	.045
8	7.921E-10	.044	8.219E-10	.052	7.341E-10	.049
9	7.358E-10	.035	6.549E-10	.039	6.340E-10	.038
10	5.637E-10	.040	5.684E-10	.040	5.146E-10	.042
11	4.661E-10	.046	4.086E-10	.049	3.936E-10	.048
12	3.109E-10	.037	3.016E-10	.035	2.741E-10	.039
13	2.202E-10	.037	2.187E-10	.041	1.935E-10	.045
14	1.487E-10	.036	1.268E-10	.049	1.226E-10	.047
15	8.572E-11	.040	8.384E-11	.039	7.013E-11	.051
16	4.512E-11	.047	4.881E-11	.042	4.059E-11	.045
17	3.478E-11	.060	3.806E-11	.054	3.199E-11	.054
18	3.509E-11	.045	3.352E-11	.050	2.621E-11	.057
19	2.822E-11	.052	3.461E-11	.050	2.045E-11	.060
20	2.885E-11	.111	2.908E-11	.105	1.206E-11	.136
21	6.778E-12	.534	4.995E-12	.598	4.831E-12	.344

* REGION

** REGION ACTIVE MARROW FRACTION

APPENDIX C
ANGLE-DIFFERENTIAL DOSE DEPOSITION FACTORS

This appendix contains tabulated active marrow dose deposition factors for incident fluence in 12 equal solid angle bins (1.047 steradians per bin) arranged in 5 polar angle bands. Figure III-16 from the report text gives the orientation of these angle bins relative to the reference man phantom and is reproduced here for the readers convenience. Also reproduced is Table II-2, which gives the boundaries for the neutron and gamma ray energy group structure. Tabulated dose deposition factors are presented for eight skeletal regions and for reference man. The reference man values have been obtained by weighting the skeletal region responses by their respective marrow fractions and taking the sum for all eight regions. Tabulated quantities include neutron (n-n), gamma ray (n-γ) and total (n-t) dose deposition per unit incident neutron fluence per angle bin and gamma ray dose (γ-γ) per unit incident gamma ray fluence per angle bin. NOTE: These angle differential values are for marrow on the right (positive X) side of the phantom only. To obtain azimuthal angle differential results for marrow located on the left (negative X) side of the phantom the recorded azimuthal responses must be transposed across the Y-Z plane. The dose deposition for the total marrow (left and right) of a body region or of reference man as a whole in a particular azimuthal angle bin is the average of the tabulated and transposed value for that bin. In such case, dose deposition in three pairs of angle bins, 2 and 3, 5 and 7, and 9 and 10, would be the respective average of each.

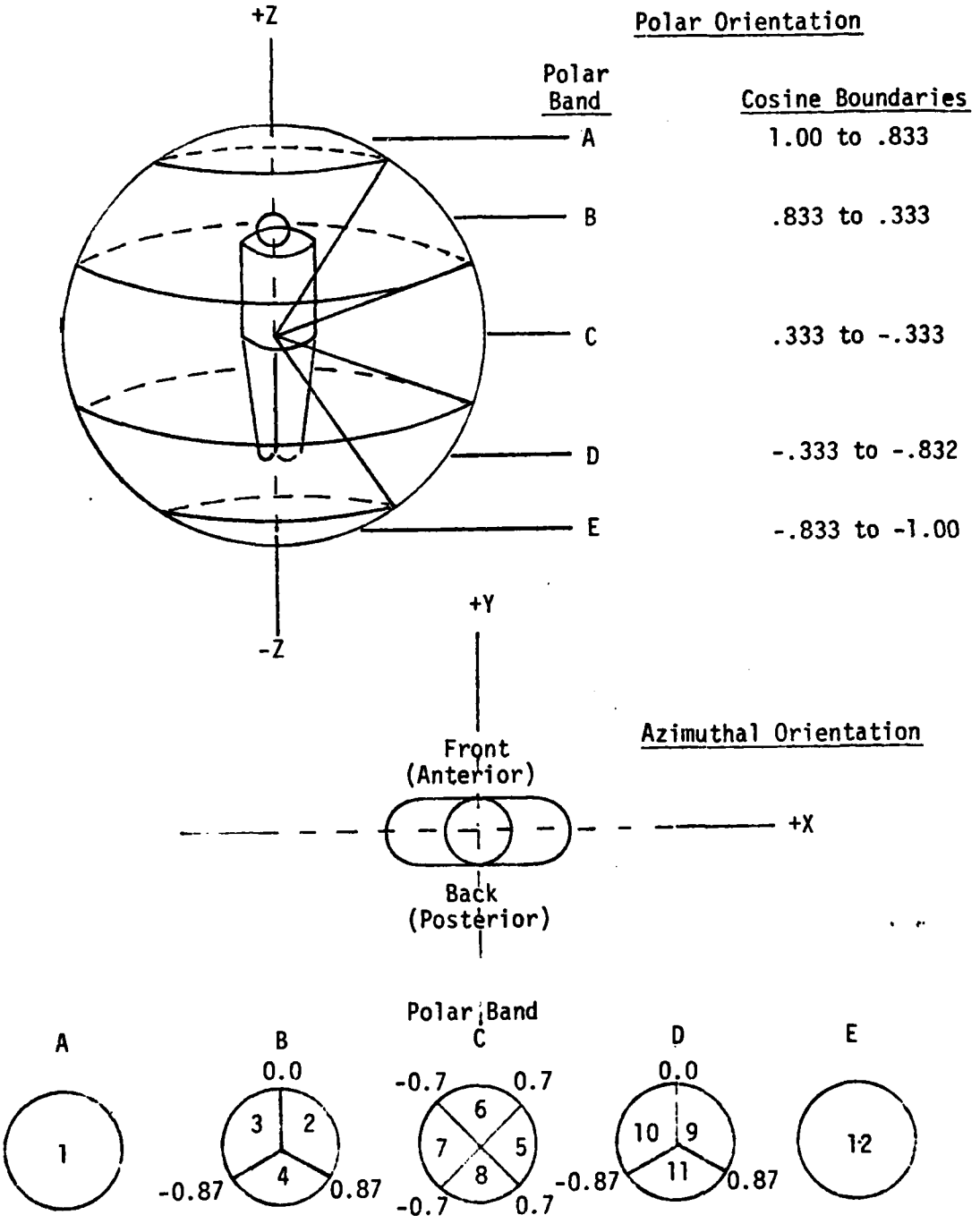
This appendix also contains tabulated data for active marrow dose deposition in reference man for incident fluence in 5 polar angle bands. These values have been obtained by averaging the azimuthal bin values in each polar band. The results are tabulated for neutron (n-n), gamma ray (n-γ) and total (n-t) dose deposition per unit incident neutron fluence per angle bin and gamma ray dose (γ-γ) per unit incident gamma ray fluence per bin. These data can be useful in situations where the population subject to analysis is erect but facing in random directions.

Table II-2 NEUTRON AND GAMMA-RAY ENERGY BOUNDARIES FOR THE 37-21 COUPLED NEUTRON-GAMMA LIBRARY

Group No.	Neutron Group (eV)		Gamma Group (eV)	
	Energy	Lethargy	Energy	Eff. Avg.
1	1.96+7*	-0.675	1.40+7	1.20+7
2	1.69+7	-0.525	1.00+7	9.00+6
3	1.49+7	-0.400	8.00+6	7.50+6
4	1.42+7	-0.350	7.00+6	6.50+6
5	1.38+7	-0.325	6.00+6	5.50+6
6	1.28+7	-0.250	5.00+6	4.50+6
7	1.22+7	-0.200	4.00+6	3.50+6
8	1.11+7	-0.100	3.00+6	2.75+6
9	1.00+7	0.000	2.50+6	2.25+6
10	9.05+6	0.100	2.00+6	1.75+6
11	8.19+6	0.200	1.50+6	1.25+6
12	7.41+6	0.300	1.00+6	8.50+5
13	6.38+6	0.450	7.00+5	5.75+5
14	4.97+6	0.700	4.50+5	3.75+5
15	4.72+6	0.750	3.00+5	2.25+5
16	4.07+6	0.900	1.50+5	1.25+5
17	3.01+6	1.200	1.00+5	8.50+4
18	2.39+6	1.433	7.00+4	5.75+4
19	2.31+6	1.467	4.50+4	3.75+4
20	1.83+6	1.700	3.00+4	2.50+4
21	1.11+6	2.200	2.00+4	1.50+4
22	5.50+5	2.900	1.00+4	
23	1.58+5	4.150		
24	1.11+5	4.500		
25	5.25+4	5.250		
26	2.48+4	6.000		
27	2.19+4	6.125		
28	1.03+4	6.875		
29	3.35+3	8.000		
30	1.23+3	9.000		
31	5.83+2	9.750		
32	1.01+2	11.500		
33	2.90+1	12.750		
34	1.07+1	13.750		
35	3.06+0	15.000		
36	1.13+0	16.000		
37	4.14-1	17.000		
38	1.00-5	27.631		

*Read as 1.96×10^7.

Figure III-16 Solid Angle Bin Orientation for Adjoint Fluence Exit
(1.0472 steradians per bin)



Azimuthal Bins and Cosine Boundaries

AZIMUTHAL AND POLAR ANGLE-DIFFERENTIAL DOSE

DEPOSITION FACTORS

Neutron Dose Deposition From Incident Neutron Fluence (n-n)

PELVIS

ENERGY	BIN 1		BIN 2		BIN 3	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.231E-10*	.154	5.834E-10	.084	2.543E-10	.132
2	1.509E-10	.171	4.804E-10	.110	2.322E-10	.145
3	1.378E-10	.202	3.747E-10	.119	2.316E-10	.146
4	1.563E-10	.182	3.346E-10	.126	1.931E-10	.168
5	2.189E-10	.177	3.188E-10	.124	2.032E-10	.154
6	1.391E-10	.184	3.774E-10	.126	2.326E-10	.161
7	1.759E-10	.189	3.612E-10	.125	1.795E-10	.179
8	7.743E-11	.285	3.101E-10	.140	1.434E-10	.232
9	5.621E-11	.307	2.775E-10	.141	1.631E-10	.224
10	1.009E-10	.235	3.226E-10	.147	1.377E-10	.217
11	9.022E-11	.307	3.305E-10	.149	1.169E-10	.262
12	8.426E-11	.362	2.935E-10	.159	8.633E-11	.299
13	6.606E-11	.330	2.352E-10	.192	1.311E-10	.254
14	5.706E-11	.415	1.887E-10	.211	8.258E-11	.284
15	5.576E-11	.379	1.828E-10	.232	2.769E-11	.506
16	8.615E-11	.393	8.608E-11	.306	4.269E-11	.432
17	3.850E-11	.514	9.086E-11	.271	9.850E-11	.328
18	3.454E-11	.696	6.708E-11	.331	6.297E-11	.461
19	0.	0.000	5.025E-11	.412	4.289E-11	.581
20	7.935E-12	.822	3.297E-11	.730	2.361E-11	.750
21	8.118E-12	.961	1.768E-11	.633	5.349E-12	.682
22	1.987E-13	1.000	6.522E-12	.819	0.	0.000
23	0.	0.000	4.539E-13	.803	0.	0.000
24	1.427E-12	1.000	1.487E-13	1.000	0.	0.000
25	0.	0.000	8.826E-12	1.000	0.	0.000
26	0.	0.000	0.	0.000	0.	0.000
27	0.	0.000	0.	0.000	0.	0.000
28	0.	0.000	0.	0.000	0.	0.000
29	0.	0.000	0.	0.000	0.	0.000
30	0.	0.000	2.336E-12	1.000	0.	0.000
31	0.	0.000	4.043E-12	1.000	0.	0.000
32	0.	0.000	4.002E-12	1.000	0.	0.000
33	0.	0.000	4.316E-12	1.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	5.178E-12	1.000
37	1.557E-13	.705	0.	0.000	0.	0.000

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	3.951E-10	.119	5.448E-10	.110	4.435E-10	.115
2	3.845E-10	.116	4.769E-10	.102	3.800E-10	.123
3	3.440E-10	.137	4.039E-10	.121	4.105E-10	.118
4	4.696E-10	.122	4.733E-10	.112	4.459E-10	.108
5	5.310E-10	.103	4.073E-10	.125	4.149E-10	.121
6	4.567E-10	.117	4.695E-10	.124	5.629E-10	.107
7	4.200E-10	.122	4.240E-10	.128	3.322E-10	.141
8	3.126E-10	.141	4.002E-10	.129	2.406E-10	.166
9	3.883E-10	.152	3.901E-10	.127	3.725E-10	.120
10	2.949E-10	.157	2.618E-10	.159	3.570E-10	.141
11	3.417E-10	.150	3.027E-10	.139	3.312E-10	.154
12	2.817E-10	.188	3.087E-10	.156	2.739E-10	.168
13	2.690E-10	.183	2.728E-10	.178	2.353E-10	.196
14	2.132E-10	.190	2.873E-10	.184	2.455E-10	.169
15	2.494E-10	.190	2.224E-10	.201	2.007E-10	.204
16	1.546E-10	.252	1.427E-10	.261	1.292E-10	.273
17	1.530E-10	.237	1.580E-10	.304	1.011E-10	.272
18	9.490E-11	.308	1.494E-10	.249	1.388E-10	.268
19	5.885E-11	.403	9.304E-11	.303	1.028E-10	.315
20	1.026E-10	.341	1.352E-10	.290	1.397E-10	.297
21	3.374E-11	.456	4.328E-11	.369	4.095E-11	.460
22	1.144E-11	.600	2.374E-12	.914	2.849E-12	.495
23	5.099E-12	.554	3.145E-12	.830	2.955E-13	.575
24	6.550E-12	.502	1.427E-12	1.000	0.	0.000
25	3.782E-12	.931	1.361E-11	1.000	0.	0.000
26	2.015E-12	.640	0.	0.000	9.750E-13	1.000
27	2.279E-11	1.000	5.323E-13	1.000	0.	0.000
28	1.670E-11	1.000	0.	0.000	0.	0.000
29	0.	0.000	7.226E-12	.705	0.	0.000
30	0.	0.000	1.963E-11	1.000	0.	0.000
31	7.898E-12	1.000	3.114E-12	1.000	0.	0.000
32	4.820E-12	1.000	0.	0.000	0.	0.000
33	0.	0.000	5.547E-12	1.000	0.	0.000
34	0.	0.000	7.906E-12	.715	0.	0.000
35	0.	0.000	2.450E-12	1.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	3.118E-13	.495	3.896E-13	.442	3.116E-13	.495

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	3.059E-10	.129	5.266E-10	.105	4.274E-10	.111
2	2.357E-10	.142	6.427E-10	.097	3.322E-10	.126
3	2.442E-10	.147	4.694E-10	.111	3.301E-10	.119
4	2.094E-10	.166	4.120E-10	.121	4.193E-10	.103
5	2.319E-10	.161	4.979E-10	.117	4.175E-10	.133
6	1.671E-10	.176	5.047E-10	.119	3.241E-10	.139
7	2.670E-10	.147	5.375E-10	.104	4.429E-10	.127
8	1.554E-10	.177	3.918E-10	.135	4.395E-10	.119
9	1.349E-10	.189	4.862E-10	.111	2.659E-10	.185
10	1.807E-10	.188	3.778E-10	.133	2.833E-10	.155
11	1.236E-10	.261	4.191E-10	.145	2.191E-10	.169
12	1.402E-10	.245	3.838E-10	.179	2.920E-10	.165
13	9.647E-11	.298	3.843E-10	.143	2.645E-10	.179
14	5.064E-11	.376	4.385E-10	.124	2.423E-10	.189
15	5.482E-11	.402	2.883E-10	.162	1.658E-10	.216
16	2.744E-11	.567	2.259E-10	.202	1.193E-10	.309
17	4.191E-11	.404	1.638E-10	.276	1.136E-10	.271
18	2.272E-11	.529	2.619E-10	.197	8.839E-11	.314
19	1.119E-11	.991	1.537E-10	.244	9.546E-11	.271
20	3.305E-12	.748	1.988E-10	.262	7.739E-12	.431
21	4.941E-13	1.000	5.294E-11	.376	3.217E-11	.493
22	0.	0.000	9.821E-12	.532	6.033E-12	.654
23	1.239E-13	1.000	2.869E-11	.500	1.809E-13	.713
24	7.173E-13	1.000	1.004E-11	.627	0.	0.000
25	0.	0.000	3.064E-12	.807	1.754E-13	1.000
26	0.	0.000	1.234E-12	1.000	0.	0.000
27	0.	0.000	1.169E-12	1.000	0.	0.000
28	0.	0.000	0.	0.000	0.	0.000
29	0.	0.000	0.	0.000	9.394E-14	1.000
30	0.	0.000	1.121E-11	.856	0.	0.000
31	0.	0.000	3.355E-12	1.000	0.	0.000
32	0.	0.000	2.569E-12	1.000	4.984E-12	1.000
33	0.	0.000	4.447E-12	1.000	0.	0.000
34	0.	0.000	4.665E-12	1.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	4.989E-12	1.000	0.	0.000
37	0.	0.000	9.357E-13	.279	7.806E-14	1.000

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	2.772E-10	.125	5.166E-10	.103	2.344E-10	.142
2	2.557E-10	.142	4.536E-10	.130	1.752E-10	.166
3	2.329E-10	.136	4.564E-10	.105	2.106E-10	.151
4	2.192E-10	.166	4.703E-10	.101	1.511E-10	.189
5	2.149E-10	.148	4.074E-10	.119	1.322E-10	.189
6	1.966E-10	.186	4.523E-10	.127	1.781E-10	.169
7	2.214E-10	.161	4.314E-10	.133	2.027E-10	.181
8	2.027E-10	.168	3.872E-10	.139	1.700E-10	.224
9	1.908E-10	.164	3.617E-10	.126	1.124E-10	.208
10	9.743E-11	.264	3.726E-10	.135	1.165E-10	.259
11	1.503E-10	.211	2.943E-10	.152	1.154E-10	.250
12	1.429E-10	.240	2.896E-10	.155	8.515E-11	.304
13	9.487E-11	.321	1.973E-10	.193	1.225E-10	.235
14	8.779E-11	.306	2.155E-10	.182	8.543E-11	.293
15	6.461E-11	.404	2.424E-10	.201	6.274E-11	.368
16	5.732E-11	.466	1.869E-10	.262	3.739E-11	.522
17	4.957E-11	.468	1.390E-10	.228	2.438E-11	.532
18	2.385E-11	.544	1.543E-10	.223	7.955E-12	.981
19	6.289E-11	.408	8.338E-11	.295	1.299E-11	.719
20	1.282E-11	.920	7.694E-11	.388	1.899E-11	.716
21	2.653E-13	1.000	1.442E-11	.673	1.137E-11	.947
22	0.	0.000	1.112E-11	.605	5.631E-13	1.000
23	0.	0.000	1.177E-11	.576	7.959E-13	1.000
24	1.175E-12	1.000	1.373E-13	1.000	0.	0.000
25	0.	0.000	0.	0.000	0.	0.000
26	0.	0.000	0.	0.000	0.	0.000
27	0.	0.000	0.	0.000	0.	0.000
28	0.	0.000	0.	0.000	2.564E-12	1.000
29	0.	0.000	0.	0.000	0.	0.000
30	2.501E-12	1.000	3.242E-13	.750	0.	0.000
31	0.	0.000	0.	0.000	0.	0.000
32	0.	0.000	7.715E-12	.695	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	2.516E-12	1.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	0.	0.000	3.116E-13	.495	2.339E-13	.574

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SPINE

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	2.772E-10	.146	3.740E-10	.124	3.530E-10	.113
2	2.316E-10	.143	3.267E-10	.124	3.062E-10	.135
3	2.237E-10	.158	3.886E-10	.119	3.007E-10	.145
4	2.325E-10	.165	3.175E-10	.145	1.774E-10	.168
5	2.512E-10	.153	2.919E-10	.141	3.225E-10	.126
6	3.143E-10	.155	2.793E-10	.149	2.770E-10	.150
7	1.973E-10	.156	2.403E-10	.168	1.916E-10	.166
8	1.663E-10	.194	2.963E-10	.160	2.504E-10	.138
9	1.354E-10	.201	2.961E-10	.185	2.274E-10	.173
10	1.765E-10	.183	2.531E-10	.164	2.293E-10	.174
11	1.956E-10	.209	1.703E-10	.188	1.865E-10	.207
12	1.156E-10	.262	2.087E-10	.198	1.944E-10	.222
13	6.398E-11	.317	1.667E-10	.211	1.703E-10	.254
14	8.510E-11	.359	2.147E-10	.199	1.029E-10	.254
15	9.585E-11	.335	1.360E-10	.231	5.819E-11	.358
16	1.670E-11	.711	3.723E-11	.470	5.774E-11	.450
17	3.543E-11	.433	6.693E-11	.331	6.831E-11	.363
18	3.097E-11	.516	7.736E-11	.314	4.603E-11	.471
19	3.399E-11	.637	1.007E-10	.332	2.434E-11	.561
20	7.767E-13	1.000	1.237E-11	.697	1.832E-11	.874
21	7.937E-14	1.000	3.000E-11	.495	1.050E-11	.775
22	6.974E-12	.712	0.	0.000	1.288E-13	1.000
23	1.960E-13	.706	1.179E-12	.886	3.025E-13	1.000
24	0.	0.000	0.	0.000	3.855E-12	1.000
25	3.321E-12	1.000	0.	0.000	0.	0.000
26	0.	0.000	0.	0.000	0.	0.000
27	0.	0.000	0.	0.000	0.	0.000
28	0.	0.000	0.	0.000	7.155E-13	1.000
29	0.	0.000	0.	0.000	0.	0.000
30	0.	0.000	0.	0.000	0.	0.000
31	0.	0.000	0.	0.000	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	7.795E-14	1.000	6.237E-13	.388	1.561E-13	.705

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	5.285E-10	.108	5.211E-10	.103	2.829E-10	.115
2	5.564E-10	.110	5.725E-10	.098	3.707E-10	.119
3	4.239E-10	.121	3.347E-10	.114	3.102E-10	.131
4	5.511E-10	.093	4.744E-10	.129	3.047E-10	.134
5	4.637E-10	.112	3.884E-10	.126	3.242E-10	.133
6	4.565E-10	.113	3.929E-10	.139	3.770E-10	.128
7	4.875E-10	.108	3.681E-10	.119	2.690E-10	.156
8	4.674E-10	.134	3.789E-10	.128	2.147E-10	.167
9	3.470E-10	.126	2.939E-10	.139	3.103E-10	.138
10	3.656E-10	.137	2.162E-10	.183	2.740E-10	.141
11	3.037E-10	.159	2.353E-10	.175	2.038E-10	.195
12	3.696E-10	.141	2.139E-10	.205	2.279E-10	.177
13	3.032E-10	.161	2.408E-10	.180	1.768E-10	.221
14	3.268E-10	.154	2.275E-10	.174	1.253E-10	.283
15	3.861E-10	.153	1.792E-10	.225	9.908E-11	.268
16	2.473E-10	.222	1.482E-10	.229	4.890E-11	.396
17	2.073E-10	.192	1.469E-10	.274	1.002E-11	.445
18	1.260E-10	.260	7.199E-11	.332	7.478E-11	.383
19	1.360E-10	.266	1.529E-10	.269	7.223E-11	.532
20	1.102E-10	.346	8.448E-11	.333	4.218E-11	.522
21	5.920E-11	.366	1.863E-11	.600	4.286E-12	1.000
22	2.149E-11	.508	8.156E-12	.551	0.	0.000
23	1.032E-11	.322	1.107E-11	.837	0.	0.000
24	7.961E-12	.604	0.	0.000	0.	0.000
25	2.096E-12	.725	7.588E-12	1.000	0.	0.000
26	3.928E-12	.766	0.	0.000	0.	0.000
27	0.	0.000	0.	0.000	0.	0.000
28	0.	0.000	0.	0.000	0.	0.000
29	0.	0.000	4.107E-12	1.000	0.	0.000
30	2.632E-12	1.000	0.	0.000	0.	0.000
31	4.350E-12	.835	0.	0.000	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	3.224E-12	1.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	1.170E-12	.264	1.560E-13	.705	7.804E-14	1.000

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	3.331E-10	.124	6.310E-10	.098	2.601E-10	.119
2	3.720E-10	.136	6.952E-10	.099	3.155E-10	.140
3	3.583E-10	.115	4.653E-10	.118	2.107E-10	.164
4	3.589E-10	.139	6.246E-10	.100	2.576E-10	.144
5	2.923E-10	.143	5.313E-10	.102	2.698E-10	.138
6	3.209E-10	.129	5.691E-10	.105	2.560E-10	.154
7	2.481E-10	.153	5.112E-10	.123	2.649E-10	.152
8	2.822E-10	.140	5.130E-10	.119	2.402E-10	.154
9	3.042E-10	.146	5.325E-10	.110	2.475E-10	.176
10	2.781E-10	.150	3.698E-10	.156	1.600E-10	.214
11	1.861E-10	.207	5.335E-10	.122	2.010E-10	.197
12	2.425E-10	.188	3.683E-10	.149	1.564E-10	.264
13	2.098E-10	.176	2.889E-10	.163	1.092E-10	.265
14	1.480E-10	.230	3.431E-10	.166	6.080E-11	.386
15	1.575E-10	.219	3.901E-10	.150	1.598E-10	.258
16	1.824E-10	.271	3.403E-10	.164	5.979E-11	.366
17	7.385E-11	.309	2.069E-10	.213	8.264E-12	.944
18	6.199E-11	.333	1.414E-10	.230	8.338E-11	.385
19	1.196E-10	.306	2.344E-10	.207	3.535E-11	.478
20	5.015E-11	.411	1.599E-10	.225	2.329E-11	1.000
21	1.305E-11	.627	1.241E-10	.249	9.017E-14	1.000
22	7.643E-12	.734	3.957E-11	.296	1.036E-13	1.000
23	1.354E-12	.763	8.206E-12	.400	0.	0.000
24	9.373E-13	1.000	5.209E-12	.470	0.	0.000
25	1.890E-13	1.000	1.997E-13	.705	0.	0.000
26	1.037E-13	1.000	5.111E-12	.977	1.667E-12	1.000
27	0.	0.000	1.924E-12	.705	0.	0.000
28	3.674E-12	1.000	2.547E-13	1.000	0.	0.000
29	0.	0.000	4.329E-13	.753	0.	0.000
30	0.	0.000	1.099E-11	.570	0.	0.000
31	0.	0.000	2.214E-12	.756	0.	0.000
32	0.	0.000	3.125E-12	.883	0.	0.000
33	0.	0.000	6.624E-12	1.000	0.	0.000
34	0.	0.000	4.026E-12	1.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	3.118E-13	.495	1.560E-12	.210	1.563E-13	.705

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	2.466E-10	.134	6.445E-10	.104	1.850E-10	.151
2	2.701E-10	.147	4.331E-10	.116	1.967E-10	.171
3	2.214E-10	.135	5.897E-10	.107	1.224E-10	.181
4	2.626E-10	.153	5.241E-10	.105	1.026E-10	.207
5	2.225E-10	.159	4.891E-10	.108	1.244E-10	.236
6	1.943E-10	.175	5.846E-10	.098	1.514E-10	.182
7	2.091E-10	.168	4.609E-10	.112	1.092E-10	.227
8	2.102E-10	.214	4.662E-10	.129	1.280E-10	.228
9	1.571E-10	.203	5.472E-10	.124	1.007E-10	.237
10	1.868E-10	.201	4.240E-10	.122	1.189E-10	.272
11	1.354E-10	.235	4.137E-10	.129	7.198E-11	.329
12	1.901E-10	.208	4.669E-10	.152	1.308E-10	.262
13	1.033E-10	.253	3.029E-10	.162	8.636E-11	.323
14	1.325E-10	.273	2.189E-10	.182	3.210E-11	.390
15	1.191E-10	.286	2.768E-10	.181	4.559E-11	.371
16	3.872E-11	.443	1.841E-10	.225	2.977E-11	.480
17	3.095E-11	.493	1.610E-10	.245	2.821E-11	.506
18	4.506E-11	.390	2.006E-10	.211	2.464E-11	.547
19	3.200E-11	.573	1.205E-10	.258	0.	0.000
20	1.889E-11	.893	1.264E-10	.265	3.043E-11	.729
21	1.334E-12	1.000	4.083E-11	.411	2.035E-12	.608
22	0.	0.000	2.173E-11	.381	4.286E-12	1.000
23	1.037E-13	1.000	5.792E-12	.435	1.037E-13	1.000
24	3.666E-13	1.000	1.430E-11	.923	0.	0.000
25	0.	0.000	1.324E-11	.627	0.	0.000
26	0.	0.000	0.	0.000	0.	0.000
27	0.	0.000	1.064E-11	.715	0.	0.000
28	0.	0.000	1.137E-13	1.000	0.	0.000
29	0.	0.000	2.049E-12	.934	0.	0.000
30	0.	0.000	1.575E-12	.761	0.	0.000
31	0.	0.000	4.473E-12	.753	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	1.018E-11	.705	0.	0.000
37	7.795E-14	1.000	9.360E-13	.279	7.806E-14	1.000

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SKULL

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	6.791E-10	.105	6.896E-10	.090	4.704E-10	.108
2	5.023E-10	.122	5.513E-10	.115	4.223E-10	.114
3	4.916E-10	.111	4.729E-10	.113	4.231E-10	.117
4	5.643E-10	.105	4.804E-10	.126	4.061E-10	.122
5	4.032E-10	.125	5.138E-10	.112	3.856E-10	.138
6	4.026E-10	.126	4.709E-10	.128	3.521E-10	.134
7	4.618E-10	.128	4.901E-10	.130	4.085E-10	.136
8	4.174E-10	.132	4.589E-10	.120	3.491E-10	.128
9	3.679E-10	.146	4.526E-10	.122	3.984E-10	.132
10	4.824E-10	.122	4.572E-10	.132	4.469E-10	.132
11	3.409E-10	.164	4.098E-10	.125	3.247E-10	.140
12	3.288E-10	.152	4.056E-10	.129	2.631E-10	.174
13	3.545E-10	.139	3.803E-10	.151	3.450E-10	.155
14	2.320E-10	.181	4.094E-10	.120	2.689E-10	.170
15	2.957E-10	.159	3.462E-10	.169	3.343E-10	.149
16	2.234E-10	.189	3.975E-10	.141	2.719E-10	.161
17	2.416E-10	.186	2.485E-10	.182	1.442E-10	.229
18	1.775E-10	.205	1.487E-10	.219	1.737E-10	.226
19	2.671E-10	.192	2.737E-10	.180	1.745E-10	.246
20	1.200E-10	.266	2.741E-10	.158	4.863E-11	.382
21	1.275E-10	.236	1.709E-10	.219	4.835E-11	.427
22	4.716E-11	.256	6.873E-11	.220	2.651E-11	.384
23	4.652E-11	.211	2.290E-11	.303	1.195E-11	.415
24	1.119E-11	.365	1.764E-11	.293	6.851E-12	.510
25	4.468E-12	.473	1.361E-11	.327	1.256E-12	.886
26	5.402E-12	.401	3.419E-12	.505	1.950E-12	.705
27	2.370E-12	.520	9.344E-12	.345	9.946E-13	.812
28	2.308E-12	.414	9.570E-13	.602	1.378E-13	1.000
29	1.004E-11	.693	3.864E-12	.866	0.	0.000
30	1.560E-13	1.000	4.838E-12	.909	0.	0.000
31	4.933E-12	1.000	0.	0.000	1.513E-13	1.000
32	5.705E-13	1.000	7.800E-14	1.000	0.	0.000
33	2.838E-12	1.000	2.403E-12	.961	5.540E-12	.735
34	1.289E-13	1.000	4.291E-13	.578	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	1.404E-12	.223	1.560E-12	.210	4.680E-13	.402

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	4.342E-10	.118	6.340E-10	.103	4.418E-10	.116
2	5.793E-10	.103	6.651E-10	.096	4.667E-10	.108
3	4.752E-10	.113	5.452E-10	.110	3.929E-10	.136
4	4.985E-10	.126	5.959E-10	.106	4.283E-10	.120
5	3.965E-10	.130	4.914E-10	.122	5.106E-10	.119
6	5.072E-10	.122	6.103E-10	.110	3.985E-10	.135
7	4.258E-10	.112	4.593E-10	.130	4.214E-10	.118
8	5.061E-10	.132	4.464E-10	.115	3.710E-10	.125
9	4.161E-10	.133	4.882E-10	.113	3.290E-10	.147
10	4.217E-10	.143	4.181E-10	.128	3.115E-10	.143
11	3.413E-10	.153	5.267E-10	.123	2.790E-10	.164
12	2.146E-10	.183	4.109E-10	.140	2.705E-10	.176
13	4.090E-10	.147	4.354E-10	.159	3.154E-10	.158
14	2.401E-10	.163	3.718E-10	.133	2.101E-10	.191
15	3.557E-10	.168	3.400E-10	.164	2.725E-10	.189
16	2.502E-10	.203	3.670E-10	.153	2.002E-10	.216
17	2.972E-10	.169	2.651E-10	.158	1.348E-10	.263
18	2.112E-10	.187	2.934E-10	.169	1.454E-10	.259
19	2.180E-10	.250	3.172E-10	.179	1.329E-10	.278
20	1.270E-10	.232	2.163E-10	.208	1.774E-10	.270
21	9.365E-11	.282	1.345E-10	.267	4.449E-11	.406
22	6.893E-11	.234	8.092E-11	.211	2.036E-11	.435
23	2.547E-11	.267	4.988E-11	.190	1.470E-11	.396
24	1.956E-11	.300	2.836E-11	.235	2.896E-12	.562
25	1.696E-11	.370	1.121E-11	.324	9.441E-12	.348
26	7.035E-12	.360	8.826E-12	.312	3.900E-12	.495
27	1.501E-11	.708	6.516E-12	.328	1.800E-12	.711
28	5.428E-13	.794	2.170E-12	.507	1.273E-13	1.000
29	1.891E-13	1.000	1.339E-12	.518	5.444E-12	1.000
30	5.229E-13	.510	3.507E-13	.732	2.275E-13	1.000
31	0.	0.000	4.443E-12	.928	9.260E-14	1.000
32	3.679E-12	.919	1.620E-13	1.000	2.756E-12	.966
33	0.	0.000	2.448E-13	.706	0.	0.000
34	3.140E-12	.964	6.016E-12	.689	1.494E-13	1.000
35	8.088E-12	.724	3.221E-12	1.000	4.289E-12	1.000
36	1.494E-13	1.000	1.560E-13	1.000	0.	0.000
37	1.794E-12	.212	2.184E-12	.179	3.120E-13	.495

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	3.506E-10	.123	5.070E-10	.114	4.704E-10	.113
2	5.710E-10	.105	4.948E-10	.114	5.301E-10	.106
3	4.629E-10	.108	4.972E-10	.117	4.059E-10	.133
4	3.466E-10	.124	5.335E-10	.102	4.385E-10	.121
5	3.289E-10	.133	5.202E-10	.117	3.679E-10	.140
6	3.471E-10	.141	4.942E-10	.108	5.461E-10	.113
7	4.065E-10	.118	5.666E-10	.100	4.072E-10	.117
8	3.411E-10	.131	4.479E-10	.142	3.626E-10	.130
9	2.850E-10	.164	4.693E-10	.130	3.934E-10	.129
10	2.857E-10	.152	3.844E-10	.137	3.784E-10	.140
11	2.359E-10	.206	3.765E-10	.131	4.086E-10	.142
12	3.351E-10	.167	3.769E-10	.136	4.261E-10	.138
13	2.130E-10	.224	3.872E-10	.138	2.421E-10	.179
14	1.854E-10	.219	3.397E-10	.155	2.396E-10	.170
15	2.669E-10	.186	2.696E-10	.172	2.237E-10	.204
16	1.368E-10	.269	2.399E-10	.198	2.337E-10	.192
17	8.124E-11	.288	1.310E-10	.268	1.331E-10	.244
18	9.013E-11	.292	2.403E-10	.204	2.002E-10	.199
19	7.469E-11	.341	1.674E-10	.222	2.170E-10	.223
20	4.795E-11	.428	2.140E-10	.193	1.040E-10	.283
21	2.843E-11	.518	1.139E-10	.246	1.193E-10	.278
22	8.361E-12	.551	4.530E-11	.277	4.517E-11	.271
23	2.600E-12	1.000	1.714E-11	.324	1.338E-11	.397
24	3.707E-12	.706	8.411E-12	.455	1.275E-11	.337
25	2.543E-13	1.000	5.903E-12	.425	4.119E-12	.470
26	1.231E-12	.845	6.626E-12	.371	2.198E-12	.645
27	0.	0.000	8.995E-13	.876	3.989E-12	.478
28	7.800E-13	.705	3.556E-12	.385	5.445E-13	1.000
29	0.	0.000	7.889E-13	.705	4.018E-13	1.000
30	0.	0.000	3.863E-12	1.000	2.671E-13	.715
31	1.574E-12	1.000	0.	0.000	3.426E-12	1.000
32	0.	0.000	1.049E-13	1.000	5.814E-12	.708
33	0.	0.000	7.800E-14	1.000	0.	0.000
34	5.354E-12	1.000	0.	0.000	0.	0.000
35	0.	0.000	0.	0.000	2.833E-13	.705
36	0.	0.000	0.	0.000	0.	0.000
37	0.	0.000	1.092E-12	.256	6.241E-13	.346

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	3.087E-10	.134	6.051E-10	.097	1.315E-10	.181
2	3.005E-10	.143	5.303E-10	.101	2.099E-10	.179
3	2.844E-10	.140	5.360E-10	.108	1.791E-10	.185
4	2.199E-10	.161	3.303E-10	.123	1.893E-10	.186
5	2.678E-10	.148	5.092E-10	.128	1.742E-10	.179
6	1.758E-10	.176	4.154E-10	.117	1.312E-10	.210
7	2.034E-10	.170	3.393E-10	.133	1.510E-10	.228
8	1.845E-10	.199	3.637E-10	.133	1.031E-10	.249
9	2.760E-10	.151	3.791E-10	.137	1.342E-10	.221
10	1.925E-10	.176	2.817E-10	.150	1.126E-10	.315
11	1.266E-10	.267	4.156E-10	.134	5.821E-11	.370
12	1.595E-10	.224	2.589E-10	.181	6.709E-11	.341
13	1.914E-10	.216	2.903E-10	.171	7.704E-11	.337
14	1.793E-10	.211	2.407E-10	.199	6.754E-11	.333
15	1.307E-10	.273	3.083E-10	.165	6.994E-11	.329
16	1.056E-10	.281	2.216E-10	.205	4.495E-11	.456
17	6.836E-11	.308	1.987E-10	.214	2.481E-11	.534
18	5.335E-11	.413	1.726E-10	.251	5.615E-11	.447
19	6.700E-11	.437	1.033E-10	.272	3.719E-11	.573
20	4.352E-11	.473	9.290E-11	.283	0.	0.000
21	2.810E-11	.472	1.142E-10	.284	4.517E-12	.958
22	1.197E-11	1.000	3.151E-11	.347	4.345E-12	.903
23	0.	0.000	8.625E-12	.439	0.	0.000
24	0.	0.000	4.477E-12	.602	1.109E-13	1.000
25	0.	0.000	2.774E-12	.611	0.	0.000
26	0.	0.000	5.728E-12	.483	1.088E-12	.901
27	0.	0.000	2.580E-12	.579	1.020E-12	1.000
28	0.	0.000	5.242E-13	1.000	0.	0.000
29	0.	0.000	4.473E-12	1.000	0.	0.000
30	0.	0.000	0.	0.000	0.	0.000
31	0.	0.000	7.152E-14	1.000	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	4.551E-12	1.000	0.	0.000	0.	0.000
34	0.	0.000	3.718E-13	.708	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	7.810E-14	1.000	2.338E-13	.574	2.341E-13	.574

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RIBS

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	3.991E-10	.126	5.116E-10	.122	3.287E-10	.119
2	3.374E-10	.147	6.231E-10	.105	3.327E-10	.137
3	3.456E-10	.127	3.810E-10	.140	3.753E-10	.142
4	4.160E-10	.113	4.780E-10	.112	3.968E-10	.134
5	3.100E-10	.150	5.013E-10	.110	2.911E-10	.146
6	4.023E-10	.129	4.512E-10	.131	2.352E-10	.166
7	2.314E-10	.163	4.905E-10	.114	3.427E-10	.139
8	3.364E-10	.139	5.175E-10	.118	3.112E-10	.163
9	2.809E-10	.163	3.928E-10	.137	2.587E-10	.163
10	2.694E-10	.160	4.408E-10	.139	2.498E-10	.166
11	3.174E-10	.193	4.675E-10	.124	1.409E-10	.224
12	1.752E-10	.218	3.973E-10	.154	1.779E-10	.222
13	2.632E-10	.178	3.155E-10	.152	2.765E-10	.166
14	2.673E-10	.168	2.747E-10	.180	2.176E-10	.183
15	1.928E-10	.208	2.549E-10	.177	1.811E-10	.235
16	1.732E-10	.227	2.797E-10	.198	1.213E-10	.249
17	1.148E-10	.362	2.166E-10	.190	1.227E-10	.250
18	2.066E-10	.214	2.435E-10	.177	1.108E-10	.259
19	1.049E-10	.272	1.891E-10	.214	5.137E-11	.427
20	9.199E-11	.319	1.983E-10	.227	4.403E-11	.447
21	4.392E-11	.399	5.769E-11	.336	3.927E-11	.528
22	1.246E-11	.470	5.164E-11	.321	1.820E-11	.466
23	1.470E-11	.359	2.146E-11	.283	1.053E-11	.341
24	1.068E-11	.433	1.231E-11	.366	6.363E-12	.510
25	9.762E-13	1.000	2.795E-12	.586	1.927E-12	.693
26	9.750E-13	1.000	1.911E-11	.534	2.962E-12	.799
27	0.	0.000	6.680E-13	.821	7.800E-13	1.000
28	0.	0.000	0.	0.000	0.	0.000
29	1.316E-13	1.000	2.934E-12	1.000	0.	0.000
30	0.	0.000	6.985E-14	1.000	5.188E-12	.909
31	0.	0.000	0.	0.000	0.	0.000
32	0.	0.000	2.204E-13	.735	1.356E-13	1.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	4.316E-12	1.000	0.	0.000	0.	0.000
36	0.	0.000	1.444E-13	1.000	4.565E-12	1.000
37	2.339E-13	.574	2.027E-12	.188	6.240E-13	.346

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	5.229E-10	.111	5.635E-10	.113	4.926E-10	.116
2	4.057E-10	.129	5.041E-10	.109	5.239E-10	.105
3	4.540E-10	.126	5.498E-10	.118	4.865E-10	.113
4	5.112E-10	.109	5.384E-10	.127	4.522E-10	.123
5	3.486E-10	.136	3.735E-10	.134	4.123E-10	.130
6	4.598E-10	.111	4.186E-10	.129	4.065E-10	.129
7	4.573E-10	.126	5.253E-10	.109	3.461E-10	.141
8	5.022E-10	.110	4.707E-10	.112	4.265E-10	.133
9	3.623E-10	.150	4.947E-10	.130	4.081E-10	.151
10	3.850E-10	.142	4.725E-10	.128	4.906E-10	.127
11	3.200E-10	.157	3.915E-10	.146	2.769E-10	.163
12	3.502E-10	.143	3.624E-10	.141	2.872E-10	.181
13	2.696E-10	.162	3.161E-10	.145	2.222E-10	.179
14	2.448E-10	.185	3.245E-10	.142	2.137E-10	.184
15	2.485E-10	.196	2.885E-10	.181	3.376E-10	.155
16	1.379E-10	.227	2.586E-10	.179	2.030E-10	.204
17	2.238E-10	.226	1.801E-10	.237	2.044E-10	.195
18	1.429E-10	.228	2.367E-10	.176	1.347E-10	.225
19	1.483E-10	.215	2.547E-10	.196	1.455E-10	.241
20	9.161E-11	.297	1.425E-10	.262	1.777E-10	.205
21	1.053E-10	.267	8.404E-11	.242	1.069E-10	.251
22	2.754E-11	.319	5.014E-11	.257	5.939E-11	.265
23	1.478E-11	.361	2.038E-11	.289	2.962E-11	.268
24	1.983E-11	.288	6.442E-12	.572	2.308E-11	.296
25	1.901E-11	.492	3.742E-12	.529	1.176E-11	.299
26	3.004E-12	.571	3.179E-12	.539	6.207E-12	.556
27	4.216E-12	.432	2.009E-12	.723	1.259E-11	.645
28	1.170E-12	.574	2.688E-12	.458	2.354E-12	.424
29	2.450E-13	1.000	0.	0.000	2.964E-12	.868
30	6.329E-13	.499	2.962E-13	.576	0.	0.000
31	1.560E-13	1.000	4.109E-12	1.000	4.893E-12	.971
32	4.581E-12	1.000	2.397E-13	.720	5.131E-12	.970
33	1.604E-13	1.000	0.	0.000	7.800E-14	1.000
34	9.211E-12	.694	0.	0.000	4.047E-12	1.000
35	9.804E-12	.694	3.077E-12	1.000	3.374E-12	.955
36	4.244E-13	.577	5.330E-12	.972	1.036E-11	.705
37	8.579E-13	.292	1.248E-12	.254	2.418E-12	.197

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	3.700E-10	.115	4.836E-10	.110	5.553E-10	.111
2	3.763E-10	.125	5.167E-10	.117	5.408E-10	.107
3	3.686E-10	.127	3.981E-10	.121	5.270E-10	.115
4	2.485E-10	.154	4.771E-10	.117	4.220E-10	.128
5	3.234E-10	.139	5.396E-10	.117	4.377E-10	.115
6	2.927E-10	.140	3.803E-10	.130	3.362E-10	.138
7	2.843E-10	.144	3.708E-10	.151	4.113E-10	.128
8	3.116E-10	.147	4.896E-10	.120	3.648E-10	.131
9	1.972E-10	.197	3.713E-10	.140	2.967E-10	.154
10	2.017E-10	.183	3.982E-10	.142	3.417E-10	.152
11	1.387E-10	.239	3.507E-10	.163	2.772E-10	.150
12	2.728E-10	.182	3.327E-10	.169	3.072E-10	.164
13	1.995E-10	.201	2.575E-10	.164	3.328E-10	.157
14	1.474E-10	.225	2.492E-10	.177	2.979E-10	.169
15	9.466E-11	.280	1.997E-10	.185	3.488E-10	.173
16	1.550E-10	.253	2.102E-10	.200	3.178E-10	.189
17	1.264E-10	.248	1.774E-10	.216	1.606E-10	.204
18	7.862E-11	.350	1.583E-10	.223	1.607E-10	.223
19	1.190E-10	.262	6.662E-11	.318	2.049E-10	.216
20	2.654E-11	.494	1.126E-10	.282	1.523E-10	.245
21	8.566E-12	.610	6.288E-11	.334	1.061E-10	.293
22	1.363E-11	.446	3.346E-11	.320	5.098E-11	.274
23	9.320E-12	.437	3.151E-11	.240	1.454E-11	.329
24	2.871E-12	.558	1.448E-11	.300	5.476E-12	.466
25	1.515E-12	.869	5.960E-12	.393	9.272E-12	.598
26	1.187E-12	.840	5.598E-12	.507	3.291E-12	.699
27	1.312E-12	.717	1.490E-12	.706	1.216E-12	.710
28	1.313E-12	.579	9.209E-13	.619	4.111E-13	1.000
29	0.	0.000	7.856E-12	.639	5.288E-13	.781
30	0.	0.000	5.755E-13	.580	2.571E-12	.884
31	0.	0.000	0.	0.000	9.717E-12	.825
32	0.	0.000	1.062E-13	1.000	9.173E-14	1.000
33	0.	0.000	8.019E-12	.705	7.794E-12	.708
34	1.053E-13	1.000	3.502E-12	.922	1.501E-13	1.000
35	0.	0.000	3.027E-12	.912	2.980E-12	1.000
36	5.180E-12	1.000	5.179E-12	1.000	1.560E-13	1.000
37	2.340E-13	.574	2.184E-12	.179	1.482E-12	.252

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	3.733E-10	.131	4.364E-10	.104	2.056E-10	.165
2	3.769E-10	.145	4.923E-10	.115	2.713E-10	.149
3	2.906E-10	.145	4.596E-10	.121	2.555E-10	.159
4	2.920E-10	.144	3.955E-10	.129	2.906E-10	.165
5	2.530E-10	.151	4.166E-10	.132	2.324E-10	.175
6	3.130E-10	.159	3.760E-10	.134	2.976E-10	.158
7	3.316E-10	.139	3.694E-10	.141	2.872E-10	.149
8	2.946E-10	.174	3.305E-10	.154	1.588E-10	.177
9	2.842E-10	.170	3.468E-10	.149	2.110E-10	.210
10	2.299E-10	.176	3.092E-10	.148	1.684E-10	.197
11	2.811E-10	.159	3.487E-10	.133	2.055E-10	.178
12	1.654E-10	.228	3.213E-10	.152	2.068E-10	.194
13	1.329E-10	.237	2.328E-10	.205	1.518E-10	.228
14	1.607E-10	.205	3.368E-10	.155	1.823E-10	.196
15	1.172E-10	.253	2.362E-10	.179	1.279E-10	.244
16	6.978E-11	.332	2.085E-10	.236	1.690E-10	.225
17	1.149E-10	.270	1.235E-10	.236	1.121E-10	.249
18	1.102E-10	.281	1.803E-10	.204	9.404E-11	.298
19	6.285E-11	.390	1.339E-10	.235	8.711E-11	.330
20	8.185E-11	.309	8.504E-11	.295	4.034E-11	.427
21	2.352E-11	.538	6.452E-11	.330	2.433E-11	.550
22	2.079E-11	.402	6.252E-11	.253	2.847E-11	.359
23	1.561E-11	.349	2.566E-11	.264	4.421E-12	.639
24	7.280E-12	.429	1.925E-11	.402	6.313E-12	.510
25	1.101E-11	.588	5.891E-12	.400	2.899E-12	.600
26	1.995E-12	.705	3.303E-12	.473	1.897E-12	.644
27	1.485E-12	.706	0.	0.000	6.786E-13	1.000
28	0.	0.000	2.700E-12	.417	5.011E-13	.808
29	5.298E-13	.780	3.990E-13	1.000	0.	0.000
30	4.080E-12	.914	2.413E-12	.893	1.112E-13	1.000
31	1.560E-13	1.000	0.	0.000	0.	0.000
32	0.	0.000	4.162E-12	1.000	1.050E-13	1.000
33	3.580E-12	1.000	0.	0.000	0.	0.000
34	3.466E-12	.960	1.509E-13	1.000	0.	0.000
35	1.494E-13	1.000	0.	0.000	0.	0.000
36	0.	0.000	3.369E-12	.956	0.	0.000
37	3.900E-13	.442	9.357E-13	.279	3.899E-13	.442

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SCAPULA

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	4.435E-10	.110	5.907E-10	.097	2.989E-10	.112
2	3.507E-10	.122	5.285E-10	.104	2.145E-10	.158
3	3.934E-10	.122	4.306E-10	.124	2.333E-10	.145
4	3.357E-10	.130	4.771E-10	.108	2.443E-10	.163
5	2.183E-10	.179	4.013E-10	.132	2.015E-10	.166
6	3.951E-10	.133	4.124E-10	.133	1.619E-10	.190
7	2.983E-10	.142	4.125E-10	.116	1.437E-10	.191
8	3.278E-10	.153	3.964E-10	.131	1.794E-10	.173
9	2.600E-10	.159	3.507E-10	.148	1.830E-10	.206
10	2.760E-10	.160	3.389E-10	.136	1.225E-10	.253
11	3.171E-10	.168	3.640E-10	.147	8.358E-11	.296
12	2.810E-10	.192	3.446E-10	.156	1.387E-10	.238
13	1.786E-10	.208	3.134E-10	.155	6.684E-11	.333
14	1.881E-10	.201	2.190E-10	.199	7.772E-11	.289
15	2.302E-10	.219	2.309E-10	.204	7.043E-11	.340
16	2.011E-10	.186	2.592E-10	.171	9.695E-12	.825
17	1.040E-10	.263	1.886E-10	.203	4.862E-11	.391
18	1.443E-10	.242	1.248E-10	.315	3.241E-11	.502
19	9.608E-11	.286	1.941E-10	.226	4.758E-11	.459
20	7.061E-11	.391	1.439E-10	.283	2.817E-11	.649
21	3.469E-11	.450	6.091E-11	.351	1.338E-11	.685
22	2.565E-11	.394	1.825E-11	.419	0.	0.000
23	1.041E-11	.448	1.094E-11	.377	0.	0.000
24	2.874E-12	.577	6.967E-12	.491	0.	0.000
25	1.750E-13	1.000	4.296E-12	.495	0.	0.000
26	2.517E-12	.657	6.307E-12	.390	0.	0.000
27	1.500E-12	.712	1.861E-12	.583	0.	0.000
28	5.363E-13	1.000	0.	0.000	0.	0.000
29	0.	0.000	0.	0.000	0.	0.000
30	4.765E-13	1.000	1.560E-13	1.000	0.	0.000
31	0.	0.000	4.202E-12	1.000	0.	0.000
32	0.	0.000	2.410E-12	1.000	0.	0.000
33	1.190E-13	1.000	3.576E-12	.960	0.	0.000
34	1.509E-13	1.000	4.268E-12	1.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	1.377E-13	1.000	0.	0.000
37	3.120E-13	.495	1.404E-12	.223	7.796E-14	1.000

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	7.212E-10	.095	7.115E-10	.096	4.050E-10	.116
2	6.128E-10	.109	6.221E-10	.103	3.984E-10	.133
3	6.841E-10	.103	5.552E-10	.106	2.942E-10	.144
4	5.808E-10	.102	5.274E-10	.107	4.120E-10	.122
5	6.949E-10	.094	5.399E-10	.110	4.394E-10	.125
6	6.082E-10	.109	4.832E-10	.112	2.611E-10	.154
7	4.846E-10	.115	5.881E-10	.111	4.018E-10	.145
8	5.343E-10	.132	5.914E-10	.108	2.693E-10	.149
9	4.599E-10	.121	5.234E-10	.114	2.543E-10	.149
10	4.765E-10	.135	3.506E-10	.137	2.936E-10	.152
11	5.609E-10	.112	5.526E-10	.116	2.651E-10	.157
12	4.968E-10	.128	3.765E-10	.146	1.194E-10	.229
13	4.916E-10	.126	2.823E-10	.162	2.038E-10	.191
14	2.384E-10	.176	3.661E-10	.134	2.128E-10	.172
15	4.794E-10	.133	3.528E-10	.152	1.915E-10	.206
16	4.899E-10	.133	2.987E-10	.163	9.040E-11	.350
17	2.630E-10	.181	3.155E-10	.169	1.068E-10	.310
18	2.940E-10	.175	2.934E-10	.169	8.306E-11	.294
19	2.633E-10	.174	3.039E-10	.179	6.919E-11	.356
20	1.536E-10	.225	2.149E-10	.196	6.497E-11	.479
21	1.336E-10	.212	1.113E-10	.275	1.676E-11	.599
22	9.284E-11	.196	6.279E-11	.232	0.	0.000
23	5.105E-11	.208	3.839E-11	.310	1.037E-13	1.000
24	2.657E-11	.263	2.056E-11	.287	0.	0.000
25	8.490E-12	.384	1.176E-11	.321	0.	0.000
26	8.251E-12	.363	3.199E-12	.529	0.	0.000
27	3.328E-12	.813	3.113E-12	.507	0.	0.000
28	2.969E-12	.435	5.731E-13	.750	0.	0.000
29	3.900E-13	1.000	3.150E-13	.719	0.	0.000
30	5.511E-13	.497	8.108E-13	.687	0.	0.000
31	0.	0.000	1.024E-11	.539	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	1.024E-11	.700	2.401E-12	.884	0.	0.000
34	3.794E-12	.924	0.	0.000	0.	0.000
35	0.	0.000	5.100E-12	.941	0.	0.000
36	3.222E-12	1.000	3.084E-12	1.000	0.	0.000
37	1.872E-12	.215	2.184E-12	.186	0.	0.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	3.174E-10	.130	6.944E-10	.100	4.970E-10	.110
2	3.467E-10	.127	5.586E-10	.120	5.453E-10	.113
3	2.508E-10	.135	6.048E-10	.104	4.414E-10	.106
4	2.608E-10	.162	6.250E-10	.103	2.910E-10	.145
5	2.647E-10	.150	5.642E-10	.113	4.043E-10	.137
6	2.127E-10	.162	6.123E-10	.111	4.069E-10	.119
7	2.096E-10	.153	5.361E-10	.130	3.158E-10	.161
8	1.835E-10	.213	6.678E-10	.103	2.881E-10	.162
9	2.010E-10	.173	6.237E-10	.103	3.503E-10	.133
10	2.025E-10	.178	4.661E-10	.144	3.569E-10	.146
11	1.976E-10	.181	5.079E-10	.118	3.097E-10	.154
12	1.663E-10	.222	5.806E-10	.129	4.086E-10	.129
13	1.859E-10	.192	3.666E-10	.148	3.567E-10	.145
14	9.202E-11	.272	4.215E-10	.153	2.839E-10	.171
15	6.401E-11	.345	4.899E-10	.120	2.523E-10	.175
16	1.059E-10	.282	4.397E-10	.129	1.949E-10	.191
17	7.963E-11	.391	2.695E-10	.158	1.860E-10	.222
18	4.576E-11	.402	2.822E-10	.161	1.605E-10	.241
19	3.920E-11	.442	3.362E-10	.154	1.569E-10	.215
20	1.689E-11	.940	2.874E-10	.174	1.500E-10	.253
21	1.584E-11	.574	2.482E-10	.166	6.800E-11	.341
22	7.181E-12	.586	1.285E-10	.173	4.093E-11	.307
23	1.384E-13	1.000	6.590E-11	.173	2.079E-11	.271
24	8.637E-13	1.000	3.272E-11	.240	7.930E-12	.429
25	1.630E-13	1.000	2.195E-11	.205	2.937E-12	.629
26	0.	0.000	1.608E-11	.485	2.389E-12	.596
27	5.323E-13	1.000	1.042E-11	.255	6.694E-12	.650
28	5.217E-13	.787	4.600E-12	.400	1.357E-13	1.000
29	0.	0.000	1.508E-12	.476	4.635E-12	1.000
30	0.	0.000	9.657E-13	.476	1.921E-13	1.000
31	0.	0.000	1.043E-13	1.000	5.919E-12	1.000
32	0.	0.000	3.959E-12	.974	3.534E-12	.918
33	0.	0.000	8.431E-12	.710	2.424E-13	.739
34	0.	0.000	1.604E-13	1.000	3.120E-13	.705
35	0.	0.000	3.222E-12	1.000	1.444E-13	1.000
36	0.	0.000	3.376E-12	.955	0.	0.000
37	3.119E-13	.495	4.368E-12	.132	1.248E-12	.283

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	2.023E-10	.173	6.325E-10	.107	2.877E-10	.162
2	2.631E-10	.139	5.602E-10	.116	2.186E-10	.157
3	1.952E-10	.149	6.749E-10	.101	2.269E-10	.152
4	1.725E-10	.165	6.272E-10	.101	3.260E-10	.135
5	1.599E-10	.181	5.226E-10	.113	3.191E-10	.156
6	1.881E-10	.166	5.214E-10	.113	2.460E-10	.167
7	2.175E-10	.166	4.213E-10	.123	2.194E-10	.182
8	2.343E-10	.162	5.558E-10	.115	2.225E-10	.183
9	1.334E-10	.207	5.298E-10	.125	2.101E-10	.189
10	1.278E-10	.221	4.824E-10	.124	2.609E-10	.200
11	1.739E-10	.223	5.604E-10	.122	2.491E-10	.158
12	7.113E-11	.342	4.889E-10	.137	1.667E-10	.232
13	1.212E-10	.295	3.755E-10	.142	1.475E-10	.210
14	6.736E-11	.306	3.448E-10	.150	1.287E-10	.226
15	4.573E-11	.413	4.231E-10	.151	5.577E-11	.363
16	4.048E-11	.451	3.613E-10	.144	1.593E-10	.240
17	5.072E-11	.383	2.155E-10	.180	9.795E-11	.291
18	4.797E-11	.392	2.658E-10	.173	9.761E-11	.334
19	2.897E-11	.543	2.021E-10	.208	6.038E-11	.497
20	2.340E-11	.574	1.831E-10	.233	5.833E-11	.372
21	1.759E-12	1.000	1.199E-10	.268	2.325E-11	.463
22	5.147E-13	1.000	6.791E-11	.224	1.982E-11	.457
23	0.	0.000	3.246E-11	.250	5.393E-12	.610
24	0.	0.000	2.766E-11	.244	4.246E-12	.594
25	0.	0.000	1.178E-11	.274	1.605E-11	.768
26	0.	0.000	6.558E-12	.354	0.	0.000
27	0.	0.000	3.357E-12	.499	7.319E-13	1.000
28	0.	0.000	4.390E-12	.358	3.900E-13	1.000
29	0.	0.000	1.786E-11	.745	0.	0.000
30	0.	0.000	4.805E-12	1.000	0.	0.000
31	0.	0.000	1.620E-13	1.000	0.	0.000
32	0.	0.000	1.851E-13	.705	5.214E-12	1.000
33	0.	0.000	3.054E-13	.605	0.	0.000
34	0.	0.000	3.150E-13	.712	0.	0.000
35	0.	0.000	5.921E-13	.497	0.	0.000
36	0.	0.000	5.319E-12	.974	0.	0.000
37	0.	0.000	2.340E-12	.190	7.799E-13	.338

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.377E-10	.175	4.720E-10	.106	4.290E-10	.114
2	1.206E-10	.213	4.103E-10	.118	2.178E-10	.134
3	1.143E-10	.195	4.167E-10	.102	3.293E-10	.120
4	9.371E-11	.238	3.557E-10	.119	2.504E-10	.155
5	1.278E-10	.201	3.830E-10	.129	2.649E-10	.148
6	1.486E-10	.204	3.408E-10	.128	2.427E-10	.147
7	9.190E-11	.258	3.229E-10	.140	1.812E-10	.193
8	1.078E-10	.233	2.741E-10	.150	1.987E-10	.200
9	1.075E-10	.245	3.126E-10	.153	2.209E-10	.181
10	1.221E-10	.278	3.005E-10	.149	2.123E-10	.171
11	1.019E-10	.282	2.287E-10	.171	1.648E-10	.228
12	7.646E-11	.322	2.764E-10	.181	2.070E-10	.206
13	4.637E-11	.385	2.225E-10	.183	1.882E-10	.206
14	3.173E-11	.402	2.131E-10	.256	1.053E-10	.265
15	3.748E-11	.493	1.601E-10	.240	8.079E-11	.343
16	4.156E-11	.472	1.868E-10	.239	1.124E-10	.286
17	9.655E-12	.783	1.249E-10	.261	7.558E-11	.314
18	3.784E-13	.711	7.879E-11	.300	2.514E-11	.536
19	1.090E-12	1.000	1.006E-10	.345	4.730E-11	.547
20	1.134E-11	.977	2.169E-11	.542	1.562E-11	.743
21	1.189E-11	.655	1.385E-12	.796	9.332E-12	.840
22	7.381E-12	1.000	1.942E-13	1.000	1.017E-11	.680
23	4.853E-13	.813	8.176E-13	.720	7.587E-14	1.000
24	0.	0.000	6.434E-13	1.000	0.	0.000
25	0.	0.000	8.362E-13	1.000	0.	0.000
26	0.	0.000	6.851E-12	1.000	0.	0.000
27	0.	0.000	2.565E-13	1.000	0.	0.000
28	0.	0.000	0.	0.000	0.	0.000
29	0.	0.000	0.	0.000	0.	0.000
30	2.476E-12	1.000	0.	0.000	0.	0.000
31	0.	0.000	1.053E-13	1.000	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	4.489E-12	1.000	0.	0.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	0.	0.000	2.338E-13	.574	7.782E-14	1.000

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	3.880E-10	.111	4.868E-10	.119	4.601E-10	.109
2	3.988E-10	.123	4.936E-10	.103	5.545E-10	.109
3	4.045E-10	.114	4.495E-10	.112	4.808E-10	.110
4	4.393E-10	.104	4.591E-10	.115	5.287E-10	.112
5	2.993E-10	.141	5.609E-10	.101	4.069E-10	.118
6	3.366E-10	.120	3.406E-10	.124	3.510E-10	.131
7	3.835E-10	.145	4.587E-10	.119	4.329E-10	.120
8	3.274E-10	.137	4.270E-10	.122	3.738E-10	.137
9	3.029E-10	.154	3.929E-10	.148	3.790E-10	.136
10	2.242E-10	.168	3.294E-10	.145	3.895E-10	.146
11	2.272E-10	.178	3.015E-10	.161	4.476E-10	.135
12	3.078E-10	.163	3.228E-10	.169	3.427E-10	.151
13	1.930E-10	.213	3.386E-10	.165	2.564E-10	.176
14	1.615E-10	.219	2.988E-10	.165	2.075E-10	.225
15	2.042E-10	.179	1.849E-10	.215	1.939E-10	.211
16	7.672E-11	.279	2.009E-10	.217	2.102E-10	.216
17	1.080E-10	.281	1.857E-10	.227	9.912E-11	.297
18	4.117E-11	.404	1.104E-10	.264	1.254E-10	.301
19	2.031E-11	.550	1.219E-10	.277	1.215E-10	.291
20	5.483E-11	.521	7.689E-11	.323	7.764E-11	.366
21	1.488E-11	.571	2.294E-11	.582	3.120E-11	.523
22	1.798E-13	.709	1.608E-12	.887	6.607E-12	.461
23	0.	0.000	5.453E-12	.447	1.508E-13	.705
24	1.651E-12	.887	0.	0.000	1.730E-12	1.000
25	0.	0.000	3.358E-12	.590	1.262E-13	1.000
26	0.	0.000	1.569E-13	1.000	0.	0.000
27	0.	0.000	0.	0.000	0.	0.000
28	5.939E-12	1.000	0.	0.000	1.348E-13	1.000
29	0.	0.000	3.554E-12	1.000	0.	0.000
30	0.	0.000	0.	0.000	0.	0.000
31	0.	0.000	0.	0.000	0.	0.000
32	0.	0.000	0.	0.000	1.065E-11	.585
33	0.	0.000	0.	0.000	4.182E-12	1.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	4.310E-12	1.000	3.561E-12	1.000
36	0.	0.000	0.	0.000	0.	0.000
37	3.898E-13	.442	2.340E-13	.574	2.337E-13	.574

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	3.380E-10	.116	5.139E-10	.102	5.233E-10	.109
2	3.658E-10	.130	5.031E-10	.096	4.983E-10	.114
3	2.660E-10	.126	4.542E-10	.109	4.423E-10	.124
4	3.464E-10	.134	4.555E-10	.107	4.261E-10	.118
5	3.485E-10	.131	5.237E-10	.112	4.074E-10	.128
6	2.647E-10	.151	3.868E-10	.136	3.699E-10	.123
7	1.721E-10	.166	4.722E-10	.115	3.416E-10	.133
8	2.502E-10	.160	4.019E-10	.120	4.110E-10	.138
9	2.216E-10	.177	3.826E-10	.122	3.633E-10	.157
10	2.109E-10	.195	3.284E-10	.142	2.753E-10	.152
11	2.442E-10	.195	3.120E-10	.145	2.769E-10	.171
12	2.030E-10	.215	3.391E-10	.208	3.273E-10	.170
13	1.029E-10	.273	2.126E-10	.199	2.514E-10	.184
14	1.357E-10	.258	2.005E-10	.176	2.340E-10	.181
15	8.868E-11	.329	1.979E-10	.196	2.145E-10	.193
16	1.026E-10	.278	1.653E-10	.208	1.216E-10	.284
17	6.936E-11	.337	1.077E-10	.290	1.207E-10	.259
18	1.136E-10	.322	1.906E-10	.226	1.242E-10	.271
19	4.384E-11	.428	1.720E-10	.223	1.763E-10	.275
20	3.229E-11	.610	1.400E-10	.274	9.152E-11	.330
21	6.889E-12	.775	4.700E-11	.406	1.951E-11	.503
22	5.943E-12	.740	6.955E-12	.610	4.797E-12	.587
23	2.004E-13	.716	3.303E-13	.602	1.763E-12	.783
24	0.	0.000	0.	0.000	4.101E-12	1.000
25	2.671E-12	1.000	8.995E-13	.891	0.	0.000
26	0.	0.000	3.165E-11	.776	2.712E-12	1.000
27	0.	0.000	0.	0.000	1.730E-12	1.000
28	5.472E-12	1.000	3.322E-12	1.000	0.	0.000
29	0.	0.000	0.	0.000	0.	0.000
30	0.	0.000	2.107E-12	.959	0.	0.000
31	0.	0.000	2.639E-12	1.000	3.139E-12	1.000
32	0.	0.000	0.	0.000	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	1.052E-11	.705	3.861E-12	1.000
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	7.784E-14	1.000	3.895E-13	.442	4.679E-13	.466

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	4.168E-10	.112	4.807E-10	.107	2.717E-10	.124
2	3.582E-10	.138	5.072E-10	.095	2.915E-10	.127
3	3.373E-10	.129	4.419E-10	.112	2.581E-10	.152
4	3.077E-10	.140	4.116E-10	.118	2.586E-10	.188
5	2.824E-10	.153	3.315E-10	.144	2.243E-10	.182
6	2.264E-10	.184	5.004E-10	.112	2.451E-10	.158
7	2.302E-10	.184	3.855E-10	.141	1.860E-10	.191
8	2.327E-10	.172	3.158E-10	.140	1.691E-10	.178
9	2.174E-10	.180	3.069E-10	.140	1.609E-10	.195
10	2.936E-10	.178	3.357E-10	.147	1.972E-10	.202
11	2.777E-10	.173	2.852E-10	.167	1.249E-10	.281
12	2.399E-10	.190	2.755E-10	.182	1.416E-10	.269
13	2.115E-10	.208	2.503E-10	.188	1.314E-10	.266
14	1.670E-10	.212	1.938E-10	.236	8.657E-11	.310
15	8.889E-11	.320	1.676E-10	.232	7.567E-11	.415
16	8.723E-11	.307	1.240E-10	.233	6.285E-11	.399
17	1.292E-10	.299	1.262E-10	.261	7.897E-11	.340
18	1.828E-10	.286	1.545E-10	.250	3.333E-11	.628
19	8.959E-11	.310	1.304E-10	.269	5.474E-11	.433
20	2.483E-11	.650	3.707E-11	.413	1.304E-11	.718
21	2.252E-11	.666	1.864E-11	.520	5.934E-12	.896
22	6.003E-13	.579	1.735E-13	.718	7.806E-13	.592
23	5.821E-13	.840	1.583E-12	1.000	0.	0.000
24	0.	0.000	2.402E-13	.736	2.473E-13	1.000
25	0.	0.000	5.517E-13	1.000	0.	0.000
26	0.	0.000	2.061E-13	1.000	0.	0.000
27	3.813E-12	1.000	2.955E-13	1.000	0.	0.000
28	0.	0.000	0.	0.000	0.	0.000
29	9.927E-12	1.000	0.	0.000	0.	0.000
30	0.	0.000	0.	0.000	0.	0.000
31	0.	0.000	2.305E-12	1.000	0.	0.000
32	0.	0.000	0.	0.000	0.	0.000
33	0.	0.000	3.593E-12	1.000	0.	0.000
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	3.327E-12	1.000	0.	0.000
36	0.	0.000	0.	0.000	0.	0.000
37	7.776E-14	1.000	3.895E-13	.442	2.337E-13	.574

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	5.218E-10	.115	6.758E-10	.099	3.863E-10	.114
2	5.011E-10	.120	5.112E-10	.103	2.676E-10	.148
3	4.484E-10	.113	4.553E-10	.119	2.859E-10	.138
4	4.703E-10	.116	6.136E-10	.110	1.936E-10	.163
5	3.641E-10	.135	6.866E-10	.104	3.499E-10	.148
6	3.428E-10	.130	5.833E-10	.108	2.416E-10	.150
7	3.782E-10	.145	4.945E-10	.116	2.443E-10	.168
8	3.411E-10	.146	5.455E-10	.117	2.025E-10	.179
9	3.437E-10	.161	4.799E-10	.125	1.582E-10	.182
10	3.520E-10	.150	4.853E-10	.118	1.932E-10	.188
11	3.849E-10	.128	5.939E-10	.115	2.402E-10	.179
12	2.028E-10	.197	4.207E-10	.134	1.492E-10	.219
13	2.736E-10	.153	4.042E-10	.145	1.249E-10	.275
14	3.124E-10	.146	4.100E-10	.141	1.073E-10	.253
15	2.632E-10	.159	3.808E-10	.150	1.250E-10	.248
16	2.742E-10	.174	3.637E-10	.179	8.964E-11	.311
17	1.930E-10	.215	3.312E-10	.143	4.479E-11	.408
18	9.620E-11	.271	2.167E-10	.205	5.441E-11	.350
19	1.868E-10	.203	2.805E-10	.172	4.769E-11	.403
20	1.038E-10	.323	2.147E-10	.226	2.196E-11	.719
21	5.973E-11	.334	1.437E-10	.217	1.746E-11	.704
22	4.417E-11	.300	7.418E-11	.212	1.149E-11	.581
23	7.198E-12	.473	2.825E-11	.259	7.419E-13	.734
24	3.203E-12	.698	2.920E-11	.219	0.	0.000
25	4.860E-13	.713	9.369E-12	.321	1.497E-13	1.000
26	2.916E-12	.515	1.882E-11	.549	0.	0.000
27	2.000E-12	.580	4.984E-12	.381	3.866E-12	1.000
28	3.900E-13	1.000	2.977E-12	.414	0.	0.000
29	0.	0.000	3.022E-12	.824	0.	0.000
30	0.	0.000	1.242E-13	1.000	0.	0.000
31	2.723E-12	1.000	5.700E-13	.501	0.	0.000
32	4.305E-12	1.000	2.441E-12	.902	0.	0.000
33	4.319E-12	1.000	1.162E-13	1.000	0.	0.000
34	0.	0.000	6.572E-12	.723	0.	0.000
35	0.	0.000	2.829E-12	1.000	0.	0.000
36	2.955E-12	1.000	2.862E-12	.949	0.	0.000
37	8.581E-13	.292	2.887E-12	.159	2.341E-13	.574

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	5.485E-10	.108	7.483E-10	.088	5.782E-10	.100
2	5.260E-10	.114	6.732E-10	.087	6.281E-10	.104
3	3.466E-10	.139	5.200E-10	.115	4.391E-10	.116
4	4.636E-10	.120	5.738E-10	.114	4.112E-10	.114
5	3.984E-10	.138	6.716E-10	.104	4.152E-10	.109
6	4.220E-10	.118	5.697E-10	.120	4.384E-10	.132
7	5.032E-10	.136	5.570E-10	.119	4.429E-10	.145
8	4.032E-10	.131	5.556E-10	.117	4.040E-10	.132
9	4.256E-10	.158	4.887E-10	.119	4.619E-10	.133
10	4.031E-10	.141	4.463E-10	.118	4.746E-10	.124
11	3.044E-10	.160	5.165E-10	.130	3.629E-10	.144
12	2.352E-10	.169	4.481E-10	.145	3.941E-10	.139
13	3.509E-10	.165	5.023E-10	.116	3.745E-10	.167
14	3.134E-10	.163	5.023E-10	.122	3.412E-10	.141
15	4.041E-10	.138	3.683E-10	.143	2.411E-10	.176
16	2.409E-10	.192	2.872E-10	.173	2.725E-10	.170
17	1.883E-10	.201	2.765E-10	.173	2.712E-10	.169
18	1.906E-10	.210	2.493E-10	.169	1.957E-10	.190
19	1.637E-10	.216	3.014E-10	.170	1.138E-10	.279
20	6.395E-11	.355	2.817E-10	.193	1.960E-10	.233
21	6.876E-11	.355	1.734E-10	.320	6.937E-11	.398
22	3.144E-11	.323	1.138E-10	.179	5.187E-11	.262
23	8.665E-12	.371	5.462E-11	.182	1.485E-11	.330
24	1.117E-11	.365	2.893E-11	.248	1.706E-11	.292
25	6.377E-12	.398	2.151E-11	.323	2.438E-12	.657
26	6.122E-12	.377	6.385E-12	.414	2.108E-12	.606
27	7.800E-13	1.000	3.104E-12	.508	3.276E-12	.546
28	1.455E-12	.579	2.126E-12	.418	1.190E-11	.860
29	0.	0.000	5.850E-12	.734	0.	0.000
30	1.112E-13	1.000	4.115E-12	.887	1.317E-13	1.000
31	0.	0.000	1.340E-11	.611	1.560E-13	1.000
32	0.	0.000	6.017E-12	.670	1.810E-12	1.000
33	1.166E-13	1.000	3.431E-12	.870	2.236E-12	.954
34	0.	0.000	0.	0.000	0.	0.000
35	0.	0.000	7.886E-12	.717	0.	0.000
36	3.120E-13	.705	1.560E-13	1.000	5.177E-12	1.000
37	7.024E-13	.325	2.653E-12	.169	7.804E-13	.307

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.985E-10	.131	5.393E-10	.110	5.992E-10	.104
2	2.464E-10	.160	4.735E-10	.117	6.065E-10	.095
3	2.283E-10	.145	4.393E-10	.109	6.260E-10	.112
4	2.599E-10	.168	5.057E-10	.121	6.025E-10	.115
5	1.942E-10	.162	4.165E-10	.118	5.342E-10	.124
6	1.967E-10	.169	4.325E-10	.121	5.471E-10	.107
7	1.482E-10	.195	4.959E-10	.112	4.780E-10	.136
8	1.156E-10	.214	5.631E-10	.122	4.639E-10	.135
9	1.320E-10	.207	5.633E-10	.104	4.966E-10	.117
10	1.474E-10	.260	4.214E-10	.149	5.474E-10	.116
11	1.229E-10	.255	3.726E-10	.138	4.676E-10	.130
12	7.723E-11	.331	3.450E-10	.165	3.877E-10	.126
13	5.780E-11	.348	3.882E-10	.134	4.330E-10	.136
14	4.643E-11	.363	3.407E-10	.148	3.580E-10	.151
15	6.190E-11	.450	3.060E-10	.205	2.937E-10	.158
16	2.702E-11	.584	3.122E-10	.161	3.099E-10	.164
17	1.599E-11	.550	2.007E-10	.193	2.213E-10	.200
18	1.183E-11	.946	3.298E-10	.165	3.445E-10	.154
19	3.310E-11	.762	2.016E-10	.198	2.284E-10	.206
20	0.	0.000	2.504E-10	.214	2.060E-10	.211
21	0.	0.000	8.209E-11	.290	1.048E-10	.251
22	0.	0.000	3.013E-11	.346	6.701E-11	.238
23	0.	0.000	1.497E-11	.315	4.024E-11	.202
24	1.594E-12	1.000	1.818E-11	.451	1.578E-11	.349
25	0.	0.000	3.814E-12	.559	9.017E-12	.354
26	0.	0.000	9.444E-13	.640	3.667E-12	.555
27	0.	0.000	4.860E-12	.584	4.709E-12	.406
28	0.	0.000	0.	0.000	1.986E-12	.473
29	0.	0.000	5.498E-13	.765	3.810E-13	.575
30	0.	0.000	0.	0.000	3.975E-12	.636
31	0.	0.000	8.183E-14	1.000	4.425E-12	.961
32	0.	0.000	0.	0.000	8.210E-14	1.000
33	0.	0.000	6.141E-12	.690	1.780E-13	.710
34	0.	0.000	0.	0.000	2.484E-13	.711
35	0.	0.000	0.	0.000	0.	0.000
36	0.	0.000	5.180E-12	1.000	5.181E-12	1.000
37	0.	0.000	1.092E-12	.256	2.653E-12	.164

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	3.100E-10	.140	5.106E-10	.111	3.575E-10	.126
2	2.763E-10	.151	5.182E-10	.119	2.902E-10	.145
3	2.087E-10	.162	4.837E-10	.108	2.438E-10	.160
4	2.627E-10	.168	3.789E-10	.124	2.144E-10	.151
5	2.196E-10	.170	4.051E-10	.125	2.609E-10	.168
6	2.323E-10	.158	4.792E-10	.121	2.832E-10	.159
7	2.353E-10	.177	4.253E-10	.117	2.551E-10	.168
8	1.888E-10	.195	3.326E-10	.136	2.066E-10	.200
9	1.150E-10	.212	4.430E-10	.130	2.880E-10	.148
10	1.837E-10	.186	3.670E-10	.156	1.835E-10	.193
11	1.112E-10	.263	2.792E-10	.151	2.190E-10	.174
12	1.485E-10	.219	2.897E-10	.168	2.069E-10	.200
13	1.416E-10	.295	3.261E-10	.187	2.092E-10	.196
14	1.434E-10	.242	2.693E-10	.158	1.482E-10	.217
15	1.228E-10	.289	3.852E-10	.163	1.168E-10	.283
16	5.778E-11	.394	1.539E-10	.215	1.300E-10	.252
17	1.725E-11	.641	1.832E-10	.210	8.224E-11	.322
18	4.924E-11	.551	1.862E-10	.224	1.153E-10	.264
19	3.113E-11	.495	1.859E-10	.232	1.027E-10	.303
20	1.736E-11	.703	9.947E-11	.275	6.837E-11	.393
21	1.454E-11	.651	1.086E-10	.251	4.132E-11	.426
22	4.257E-13	.615	4.313E-11	.287	2.115E-12	.621
23	5.828E-13	1.000	1.703E-11	.365	9.919E-12	.401
24	1.950E-12	1.000	9.965E-12	.411	0.	0.000
25	0.	0.000	8.933E-12	.365	1.411E-12	.924
26	0.	0.000	5.082E-12	.441	9.750E-13	1.000
27	0.	0.000	1.854E-12	.769	0.	0.000
28	0.	0.000	0.	0.000	5.363E-13	1.000
29	1.317E-13	1.000	1.722E-13	1.000	1.137E-13	1.000
30	0.	0.000	0.	0.000	1.112E-13	1.000
31	0.	0.000	5.906E-12	1.000	0.	0.000
32	0.	0.000	1.037E-13	1.000	0.	0.000
33	0.	0.000	0.	0.000	0.	0.000
34	0.	0.000	1.505E-13	1.000	0.	0.000
35	0.	0.000	1.560E-13	1.000	3.101E-12	1.000
36	0.	0.000	0.	0.000	1.560E-13	1.000
37	7.800E-14	1.000	6.243E-13	.346	3.120E-13	.495

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CLAVICLE

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	4.417E-10	.116	6.761E-10	.108	5.176E-10	.106
2	4.954E-10	.107	5.943E-10	.116	6.158E-10	.102
3	3.625E-10	.131	6.544E-10	.100	5.040E-10	.114
4	4.729E-10	.122	5.097E-10	.109	5.563E-10	.100
5	4.254E-10	.137	6.390E-10	.104	4.566E-10	.133
6	4.790E-10	.132	5.463E-10	.122	4.481E-10	.123
7	3.831E-10	.133	5.182E-10	.112	4.585E-10	.127
8	4.166E-10	.128	4.780E-10	.118	3.559E-10	.134
9	3.724E-10	.145	5.620E-10	.118	3.499E-10	.141
10	3.504E-10	.140	4.567E-10	.126	3.425E-10	.150
11	3.759E-10	.151	4.939E-10	.128	3.984E-10	.138
12	3.561E-10	.155	3.989E-10	.146	3.947E-10	.135
13	3.157E-10	.163	4.357E-10	.139	2.315E-10	.197
14	3.133E-10	.140	4.703E-10	.138	2.894E-10	.161
15	2.259E-10	.194	4.443E-10	.132	2.677E-10	.183
16	2.960E-10	.174	3.237E-10	.154	2.965E-10	.169
17	2.807E-10	.163	2.443E-10	.202	1.571E-10	.232
18	1.878E-10	.211	2.196E-10	.197	1.807E-10	.228
19	1.510E-10	.223	2.317E-10	.192	1.895E-10	.238
20	1.612E-10	.242	2.675E-10	.173	1.874E-10	.210
21	1.059E-10	.249	1.591E-10	.214	7.107E-11	.324
22	6.267E-11	.253	8.062E-11	.199	3.260E-11	.327
23	1.533E-11	.307	4.751E-11	.193	1.944E-11	.334
24	1.453E-11	.318	2.206E-11	.260	1.253E-11	.320
25	5.716E-12	.391	3.907E-12	.472	4.814E-12	.408
26	6.188E-12	.373	5.473E-12	.445	2.599E-12	.879
27	2.733E-12	.582	3.309E-12	.580	1.536E-12	.855
28	7.155E-13	1.000	6.991E-12	.814	5.553E-13	.797
29	5.107E-13	.798	9.198E-12	.742	5.682E-12	.932
30	0.	0.000	6.715E-12	.908	0.	0.000
31	2.673E-12	.971	0.	0.000	0.	0.000
32	1.684E-12	1.000	1.248E-13	1.000	2.271E-13	.711
33	5.178E-12	1.000	0.	0.000	3.813E-12	1.000
34	5.973E-12	1.000	0.	0.000	4.632E-12	1.000
35	1.560E-13	1.000	0.	0.000	1.560E-13	1.000
36	0.	0.000	5.180E-12	1.000	5.336E-12	.971
37	1.404E-12	.249	2.262E-12	.201	1.404E-12	.236

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	3.720E-10	.135	5.578E-10	.105	7.289E-10	.096
2	3.740E-10	.127	5.430E-10	.114	6.649E-10	.106
3	4.375E-10	.128	4.711E-10	.137	5.762E-10	.116
4	4.094E-10	.109	4.994E-10	.111	6.384E-10	.102
5	4.830E-10	.120	5.075E-10	.127	5.561E-10	.110
6	3.398E-10	.141	3.156E-10	.144	6.195E-10	.118
7	3.355E-10	.132	4.837E-10	.123	5.306E-10	.128
8	3.474E-10	.138	3.622E-10	.150	4.400E-10	.123
9	2.484E-10	.148	3.785E-10	.135	5.182E-10	.125
10	2.079E-10	.182	4.505E-10	.121	4.762E-10	.119
11	3.421E-10	.150	3.374E-10	.135	3.995E-10	.128
12	2.448E-10	.187	3.311E-10	.150	3.842E-10	.135
13	1.811E-10	.187	3.870E-10	.149	4.404E-10	.136
14	1.888E-10	.202	2.971E-10	.178	5.217E-10	.109
15	2.004E-10	.188	2.898E-10	.191	4.250E-10	.141
16	1.304E-10	.252	2.269E-10	.183	3.613E-10	.157
17	1.164E-10	.260	2.120E-10	.186	3.283E-10	.153
18	9.828E-11	.294	1.317E-10	.230	2.585E-10	.178
19	5.082E-11	.489	1.225E-10	.254	2.547E-10	.196
20	8.690E-11	.314	1.515E-10	.243	2.609E-10	.203
21	4.259E-11	.402	7.468E-11	.331	1.553E-10	.226
22	1.168E-11	.523	3.024E-11	.319	6.928E-11	.219
23	3.821E-12	.712	1.132E-11	.453	5.561E-11	.245
24	1.667E-11	.661	5.278E-12	.494	2.280E-11	.262
25	4.034E-12	.513	2.789E-12	.523	2.300E-11	.278
26	3.118E-12	.530	2.150E-13	1.000	1.095E-11	.291
27	1.112E-13	1.000	3.357E-12	.499	1.340E-11	.447
28	0.	0.000	5.323E-13	1.000	5.720E-12	.732
29	2.900E-13	1.000	3.900E-13	1.000	6.006E-12	.859
30	0.	0.000	0.	0.000	1.560E-13	1.000
31	0.	0.000	0.	0.000	5.900E-12	.954
32	0.	0.000	0.	0.000	7.829E-12	.561
33	3.604E-12	1.000	8.957E-14	1.000	6.557E-12	.696
34	0.	0.000	4.029E-12	.965	1.015E-11	.685
35	0.	0.000	1.501E-13	1.000	3.097E-12	.957
36	0.	0.000	0.	0.000	0.	0.000
37	3.898E-13	.442	1.403E-12	.223	3.900E-12	.166

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.880E-10	.135	2.855E-10	.129	4.952E-10	.109
2	4.193E-10	.130	3.364E-10	.128	4.898E-10	.115
3	3.263E-10	.155	2.389E-10	.146	4.955E-10	.115
4	3.172E-10	.150	1.970E-10	.181	4.724E-10	.118
5	3.281E-10	.144	2.202E-10	.146	3.982E-10	.129
6	3.773E-10	.138	2.536E-10	.142	3.942E-10	.137
7	2.963E-10	.150	2.920E-10	.138	3.889E-10	.126
8	3.049E-10	.151	1.734E-10	.186	3.476E-10	.148
9	2.227E-10	.172	1.561E-10	.186	3.185E-10	.150
10	2.067E-10	.188	1.676E-10	.181	3.598E-10	.138
11	3.128E-10	.180	1.705E-10	.193	4.918E-10	.134
12	1.935E-10	.198	3.094E-10	.206	3.195E-10	.157
13	2.657E-10	.167	1.057E-10	.322	4.340E-10	.134
14	2.232E-10	.174	9.089E-11	.274	4.265E-10	.128
15	1.720E-10	.205	9.208E-11	.276	3.225E-10	.154
16	1.282E-10	.269	3.289E-11	.478	3.274E-10	.155
17	1.512E-10	.242	4.573E-11	.419	2.419E-10	.177
18	1.596E-10	.241	3.327E-11	.446	2.021E-10	.204
19	7.032E-11	.351	4.912E-11	.400	1.473E-10	.234
20	5.730E-11	.379	5.311E-11	.444	1.206E-10	.246
21	5.602E-11	.408	2.272E-12	.682	9.925E-11	.263
22	9.303E-12	.523	8.502E-13	1.000	3.488E-11	.325
23	4.249E-12	.495	2.702E-12	.716	1.819E-11	.276
24	2.694E-12	.737	0.	0.000	6.000E-12	.404
25	0.	0.000	0.	0.000	5.632E-12	.388
26	1.087E-12	.902	0.	0.000	3.524E-12	.465
27	0.	0.000	0.	0.000	5.900E-12	.440
28	0.	0.000	0.	0.000	6.435E-13	.844
29	0.	0.000	0.	0.000	0.	0.000
30	0.	0.000	0.	0.000	3.840E-13	.587
31	0.	0.000	0.	0.000	1.762E-12	1.000
32	3.385E-12	1.000	0.	0.000	2.545E-12	1.000
33	1.210E-13	1.000	0.	0.000	5.961E-12	1.000
34	0.	0.000	0.	0.000	1.094E-13	1.000
35	0.	0.000	0.	0.000	1.043E-13	1.000
36	2.995E-13	.705	0.	0.000	0.	0.000
37	1.559E-13	.705	3.119E-13	.495	1.248E-12	.254

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	4.518E-10	.117	2.217E-10	.132	3.030E-10	.146
2	4.011E-10	.120	1.888E-10	.143	2.674E-10	.154
3	4.874E-10	.111	2.268E-10	.145	2.210E-10	.169
4	4.164E-10	.120	1.773E-10	.165	2.257E-10	.160
5	3.777E-10	.139	1.750E-10	.166	1.513E-10	.195
6	3.749E-10	.140	2.349E-10	.171	2.733E-10	.158
7	4.398E-10	.127	1.531E-10	.180	2.189E-10	.183
8	4.240E-10	.127	1.492E-10	.193	2.225E-10	.184
9	3.428E-10	.151	1.162E-10	.219	2.062E-10	.195
10	3.691E-10	.142	8.567E-11	.251	2.165E-10	.172
11	3.287E-10	.167	2.070E-10	.182	1.962E-10	.210
12	2.628E-10	.186	1.845E-10	.226	1.718E-10	.216
13	3.307E-10	.150	1.224E-10	.286	1.374E-10	.240
14	2.192E-10	.192	7.094E-11	.305	9.223E-11	.264
15	3.515E-10	.146	7.445E-11	.354	1.120E-10	.271
16	2.462E-10	.188	4.643E-11	.409	8.701E-11	.367
17	1.831E-10	.214	1.163E-11	.729	9.381E-11	.313
18	1.470E-10	.214	3.230E-11	.494	1.354E-10	.273
19	9.919E-11	.284	1.931E-12	1.000	4.725E-11	.466
20	1.239E-10	.267	1.369E-11	1.000	4.771E-11	.394
21	7.238E-11	.291	0.	0.000	2.782E-11	.521
22	3.853E-11	.302	0.	0.000	4.125E-13	1.000
23	1.288E-11	.294	0.	0.000	4.413E-12	.474
24	1.461E-11	.344	0.	0.000	2.811E-12	.697
25	1.136E-11	.512	0.	0.000	1.045E-12	.902
26	1.037E-12	.905	0.	0.000	9.057E-13	.800
27	2.279E-12	.540	0.	0.000	0.	0.000
28	5.102E-13	.798	0.	0.000	0.	0.000
29	4.811E-13	.850	0.	0.000	0.	0.000
30	5.601E-12	1.000	0.	0.000	0.	0.000
31	0.	0.000	0.	0.000	0.	0.000
32	1.881E-12	1.000	0.	0.000	0.	0.000
33	4.824E-12	.724	0.	0.000	0.	0.000
34	4.983E-12	1.000	0.	0.000	1.262E-13	1.000
35	0.	0.000	0.	0.000	4.652E-12	1.000
36	5.180E-12	1.000	0.	0.000	1.501E-13	1.000
37	1.014E-12	.267	0.	0.000	1.560E-13	.705

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REFERENCE MAN

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	3.327E-10	.140	5.298E-10	.102	3.337E-10	.120
2	2.595E-10	.152	4.626E-10	.114	2.938E-10	.137
3	2.506E-10	.163	4.025E-10	.120	3.002E-10	.140
4	2.751E-10	.158	3.792E-10	.128	2.478E-10	.157
5	2.641E-10	.160	3.738E-10	.126	2.790E-10	.143
6	2.722E-10	.159	3.762E-10	.133	2.617E-10	.155
7	2.349E-10	.168	3.630E-10	.137	2.336E-10	.165
8	1.972E-10	.211	3.568E-10	.140	2.262E-10	.178
9	1.647E-10	.226	3.307E-10	.151	2.280E-10	.187
10	2.075E-10	.193	3.377E-10	.147	2.221E-10	.186
11	1.977E-10	.235	3.148E-10	.154	1.734E-10	.223
12	1.502E-10	.275	3.006E-10	.165	1.627E-10	.242
13	1.360E-10	.276	2.526E-10	.184	1.857E-10	.234
14	1.237E-10	.323	2.449E-10	.191	1.309E-10	.247
15	1.269E-10	.310	2.077E-10	.213	1.019E-10	.365
16	1.040E-10	.425	1.540E-10	.306	9.103E-11	.390
17	8.088E-11	.419	1.305E-10	.261	9.503E-11	.320
18	7.740E-11	.494	1.072E-10	.289	7.035E-11	.411
19	6.595E-11	.459	1.241E-10	.319	5.856E-11	.500
20	3.656E-11	.715	8.767E-11	.547	2.997E-11	.692
21	2.908E-11	.760	5.145E-11	.487	1.772E-11	.660
22	1.286E-11	.712	2.021E-11	.591	6.492E-12	.719
23	8.550E-12	.519	7.541E-12	.664	3.053E-12	.729
24	3.503E-12	.737	4.887E-12	.709	2.842E-12	.765
25	1.737E-12	.860	5.742E-12	.754	4.410E-13	.792
26	1.082E-12	.639	3.405E-12	.551	5.991E-13	.755
27	4.642E-13	.573	1.539E-12	.598	3.079E-13	.899
28	3.470E-13	.642	2.938E-13	.601	2.301E-13	.992
29	1.337E-12	.826	1.010E-12	.907	9.091E-14	.932
30	1.374E-13	1.000	1.604E-12	.980	5.292E-13	.909
31	7.408E-13	.997	1.680E-12	.980	1.982E-14	1.000
32	1.835E-13	1.000	1.645E-12	.957	1.746E-14	.961
33	7.130E-13	1.000	2.051E-12	.988	7.867E-13	.764
34	1.197E-13	1.000	3.860E-13	.695	7.411E-14	1.000
35	4.427E-13	1.000	5.375E-14	1.000	2.496E-15	1.000
36	5.614E-14	1.000	1.586E-13	.995	2.426E-12	.999
37	3.400E-13	.686	7.556E-13	.307	2.029E-13	.609

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	4.691E-10	.113	5.615E-10	.107	4.086E-10	.114
2	4.750E-10	.114	5.439E-10	.101	4.202E-10	.117
3	4.153E-10	.126	4.299E-10	.117	3.877E-10	.124
4	5.039E-10	.111	5.007E-10	.117	4.081E-10	.119
5	4.714E-10	.114	4.283E-10	.124	4.046E-10	.125
6	4.637E-10	.116	4.562E-10	.127	4.486E-10	.123
7	4.457E-10	.118	4.358E-10	.122	3.398E-10	.141
8	4.147E-10	.134	4.199E-10	.124	2.820E-10	.154
9	3.763E-10	.141	3.945E-10	.129	3.514E-10	.134
10	3.475E-10	.147	3.042E-10	.156	3.434E-10	.140
11	3.341E-10	.153	3.385E-10	.148	2.856E-10	.167
12	3.147E-10	.165	3.075E-10	.166	2.610E-10	.174
13	3.051E-10	.168	2.986E-10	.170	2.330E-10	.194
14	2.530E-10	.176	2.936E-10	.166	2.067E-10	.207
15	3.135E-10	.173	2.410E-10	.198	1.989E-10	.214
16	2.061E-10	.229	1.992E-10	.220	1.309E-10	.291
17	1.982E-10	.213	1.829E-10	.256	9.724E-11	.311
18	1.332E-10	.265	1.622E-10	.250	1.209E-10	.295
19	1.209E-10	.317	1.716E-10	.256	1.042E-10	.363
20	1.065E-10	.325	1.368E-10	.283	1.179E-10	.356
21	6.100E-11	.378	5.785E-11	.410	3.856E-11	.589
22	2.733E-11	.476	2.461E-11	.595	1.210E-11	.433
23	1.230E-11	.408	1.616E-11	.635	6.237E-12	.520
24	1.103E-11	.486	6.510E-12	.704	3.489E-12	.495
25	6.719E-12	.703	1.008E-11	.795	2.855E-12	.428
26	3.635E-12	.611	1.765E-12	.517	1.712E-12	.793
27	1.082E-11	.845	1.513E-12	.768	1.797E-12	.658
28	6.631E-12	.849	6.348E-13	.548	5.796E-13	.785
29	7.313E-14	1.000	4.225E-12	.790	1.112E-12	.937
30	9.090E-13	.761	7.300E-12	.856	3.480E-14	1.000
31	4.110E-12	.937	2.874E-12	.941	6.086E-13	.986
32	2.694E-12	.982	1.600E-13	.862	1.449E-12	.901
33	5.678E-13	.922	2.222E-12	.919	3.143E-13	.967
34	1.533E-12	.859	3.714E-12	.716	5.948E-13	.980
35	2.059E-12	.711	3.099E-12	.992	1.091E-12	.981
36	2.234E-13	.838	7.150E-13	.991	1.155E-12	.751
37	8.919E-13	.352	7.853E-13	.447	5.085E-13	.608

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	3.255E-10	.125	5.532E-10	.105	4.099E-10	.113
2	3.461E-10	.133	6.079E-10	.104	3.989E-10	.124
3	3.201E-10	.129	4.663E-10	.115	3.441E-10	.133
4	2.842E-10	.150	5.052E-10	.112	3.746E-10	.123
5	2.779E-10	.148	5.127E-10	.113	3.720E-10	.133
6	2.570E-10	.152	5.042E-10	.115	3.461E-10	.137
7	2.735E-10	.147	5.096E-10	.116	3.743E-10	.135
8	2.383E-10	.159	4.570E-10	.128	3.558E-10	.135
9	2.168E-10	.173	4.843E-10	.117	2.935E-10	.167
10	2.262E-10	.173	3.783E-10	.143	2.762E-10	.168
11	1.687E-10	.229	4.343E-10	.138	2.603E-10	.169
12	2.116E-10	.211	3.791E-10	.163	2.818E-10	.187
13	1.609E-10	.236	3.329E-10	.155	2.343E-10	.198
14	1.137E-10	.286	3.619E-10	.152	2.029E-10	.237
15	1.196E-10	.302	3.092E-10	.164	2.013E-10	.217
16	1.070E-10	.383	2.651E-10	.191	1.483E-10	.286
17	6.886E-11	.343	1.749E-10	.246	9.889E-11	.446
18	5.495E-11	.413	2.102E-10	.213	1.205E-10	.300
19	6.524E-11	.575	1.782E-10	.235	1.148E-10	.313
20	2.738E-11	.579	1.816E-10	.243	5.510E-11	.535
21	1.040E-11	.748	9.105E-11	.313	4.571E-11	.573
22	5.375E-12	.631	3.116E-11	.400	1.731E-11	.631
23	1.803E-12	.853	2.168E-11	.410	5.421E-12	.551
24	1.419E-12	.909	9.609E-12	.498	3.162E-12	.462
25	3.509E-13	.978	3.707E-12	.653	1.951E-12	.778
26	3.292E-13	.928	5.330E-12	.818	1.441E-12	.822
27	1.594E-13	.808	1.832E-12	.816	1.218E-12	.619
28	1.513E-12	.848	9.792E-13	.754	1.678E-13	.960
29	0.	0.000	1.110E-12	.700	3.703E-13	.954
30	0.	0.000	7.872E-12	.747	3.882E-13	.802
31	2.061E-13	1.000	1.950E-12	.908	1.956E-12	.948
32	5.416E-14	1.000	2.032E-12	.963	2.787E-12	.938
33	1.935E-15	1.000	4.840E-12	.947	9.054E-13	.742
34	7.121E-13	1.000	3.597E-12	.977	1.835E-13	.912
35	0.	0.000	4.634E-13	.940	3.497E-13	.870
36	5.331E-13	.960	2.595E-12	.996	1.143E-13	1.000
37	1.328E-13	.558	1.398E-12	.248	4.536E-13	.672

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.876E-10	.131	5.557E-10	.103	2.114E-10	.152
2	2.850E-10	.143	4.659E-10	.119	2.058E-10	.165
3	2.480E-10	.137	5.118E-10	.109	1.894E-10	.165
4	2.441E-10	.158	4.585E-10	.110	1.714E-10	.187
5	2.305E-10	.153	4.438E-10	.120	1.609E-10	.198
6	2.093E-10	.177	4.794E-10	.118	1.859E-10	.176
7	2.307E-10	.163	4.146E-10	.128	1.768E-10	.197
8	2.178E-10	.185	4.013E-10	.136	1.522E-10	.219
9	2.012E-10	.178	4.188E-10	.131	1.334E-10	.215
10	1.637E-10	.217	3.680E-10	.137	1.348E-10	.256
11	1.644E-10	.219	3.604E-10	.141	1.148E-10	.275
12	1.630E-10	.229	3.465E-10	.159	1.179E-10	.277
13	1.253E-10	.270	2.549E-10	.181	1.127E-10	.272
14	1.251E-10	.267	2.362E-10	.184	8.124E-11	.311
15	9.983E-11	.329	2.660E-10	.189	6.743E-11	.349
16	6.299E-11	.409	1.960E-10	.236	5.902E-11	.445
17	5.801E-11	.422	1.535E-10	.238	4.229E-11	.469
18	5.219E-11	.434	1.765E-10	.224	3.713E-11	.648
19	5.401E-11	.459	1.098E-10	.280	2.614E-11	.590
20	2.844E-11	.750	9.690E-11	.331	2.499E-11	.655
21	8.930E-12	.853	4.688E-11	.476	1.034E-11	.770
22	4.360E-12	.730	2.479E-11	.449	5.922E-12	.873
23	1.861E-12	.818	1.160E-11	.481	1.286E-12	.909
24	1.543E-12	.912	8.187E-12	.804	9.167E-13	.778
25	1.305E-12	.578	5.482E-12	.574	1.110E-12	.703
26	2.200E-13	.732	1.506E-12	.517	3.690E-13	.804
27	3.328E-13	.760	3.568E-12	.684	2.379E-13	1.000
28	8.164E-15	.798	5.871E-13	.840	1.008E-12	.963
29	4.415E-13	.858	2.069E-12	.947	2.160E-15	1.000
30	1.411E-12	.982	1.042E-12	.787	1.346E-14	1.000
31	1.591E-14	1.000	1.487E-12	.865	0.	0.000
32	3.010E-14	1.000	3.228E-12	.765	1.650E-13	1.000
33	1.039E-12	.982	1.512E-13	.779	0.	0.000
34	4.332E-13	.965	9.928E-13	.921	2.020E-15	1.000
35	1.524E-14	1.000	1.578E-13	.770	1.334E-13	1.000
36	8.288E-14	1.000	3.489E-12	.794	5.365E-15	1.000
37	9.281E-14	.884	6.437E-13	.401	2.320E-13	.671

AZIMUTHAL AND POLAR ANGLE-DIFFERENTIAL DOSE

DEPOSITION FACTORS

Gamma Ray Dose Deposition From Incident Neutron Fluence (n-γ)

PELVIS

ENERGY	BIN 1		BIN 2		BIN 3	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	8.405E-12*	.311	1.414E-11	.280	1.734E-11	.339
2	1.163E-11	.359	1.483E-11	.294	1.015E-11	.361
3	1.110E-11	.299	1.718E-11	.258	1.305E-11	.300
4	9.792E-12	.287	2.249E-11	.240	2.792E-11	.292
5	7.609E-12	.360	1.602E-11	.272	1.243E-11	.346
6	1.499E-11	.339	2.901E-11	.264	2.419E-11	.287
7	5.348E-12	.288	2.279E-11	.334	2.130E-11	.288
8	8.685E-12	.327	2.235E-11	.278	9.001E-12	.321
9	1.100E-11	.397	3.673E-11	.215	1.185E-11	.320
10	4.985E-12	.700	1.317E-11	.347	1.016E-11	.428
11	1.867E-11	.387	1.502E-11	.404	8.965E-12	.433
12	1.698E-11	.424	1.579E-11	.403	4.806E-12	.512
13	7.243E-12	.546	1.343E-11	.431	4.720E-12	.555
14	5.507E-12	.597	2.865E-11	.331	3.271E-12	.621
15	3.304E-12	.574	1.312E-11	.388	5.829E-12	.759
16	1.085E-12	.793	1.999E-11	.351	1.037E-11	.427
17	1.188E-11	.443	2.080E-11	.327	1.127E-11	.415
18	1.149E-12	.583	2.010E-11	.365	7.640E-12	.682
19	8.766E-12	.590	7.693E-12	.606	1.400E-11	.462
20	1.989E-12	.543	3.460E-11	.307	2.406E-11	.354
21	6.988E-12	.725	1.313E-11	.410	1.022E-11	.425
22	5.279E-12	.567	1.608E-11	.341	1.474E-12	.467
23	3.411E-12	.567	1.103E-11	.380	4.927E-12	.630
24	2.682E-12	.963	9.482E-12	.779	2.818E-12	.935
25	3.706E-12	.744	1.587E-11	.396	6.198E-12	.674
26	2.990E-12	1.000	1.428E-11	.531	6.692E-12	.842
27	0.	0.000	2.317E-11	.408	8.194E-12	.727
28	4.288E-12	1.000	9.798E-12	.731	1.697E-12	1.000
29	9.247E-12	.602	1.917E-11	.407	7.813E-12	.788
30	8.347E-12	.713	1.877E-11	.622	4.934E-12	.766
31	0.	0.000	6.108E-12	.711	0.	0.000
32	2.212E-12	1.000	1.356E-11	.383	8.384E-12	.632
33	5.578E-12	.712	2.217E-11	.353	8.077E-12	.791
34	2.624E-12	1.000	1.505E-11	.515	3.092E-12	1.000
35	2.509E-12	1.000	5.324E-12	.707	3.914E-12	1.000
36	0.	0.000	5.941E-12	1.000	0.	0.000
37	8.578E-13	.867	4.242E-12	.379	3.517E-12	.431

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.112E-11*	.260	2.798E-11	.285	2.200E-11	.223
2	2.600E-11	.232	2.498E-11	.238	2.401E-11	.240
3	1.499E-11	.194	2.055E-11	.250	2.818E-11	.249
4	5.005E-11	.195	1.958E-11	.300	2.059E-11	.243
5	2.494E-11	.295	2.082E-11	.237	2.785E-11	.264
6	2.505E-11	.246	2.601E-11	.242	3.701E-11	.258
7	1.658E-11	.254	2.898E-11	.236	2.995E-11	.232
8	1.467E-11	.279	3.350E-11	.235	3.672E-11	.229
9	2.258E-11	.306	2.849E-11	.275	2.447E-11	.290
10	2.374E-11	.288	3.634E-11	.242	2.185E-11	.303
11	1.771E-11	.333	3.266E-11	.259	2.024E-11	.305
12	1.691E-11	.369	2.579E-11	.345	2.540E-11	.287
13	1.494E-11	.414	7.329E-12	.437	2.876E-11	.317
14	2.243E-11	.295	1.130E-11	.380	2.323E-11	.292
15	1.347E-11	.397	2.478E-11	.402	1.407E-11	.475
16	1.446E-11	.393	1.924E-11	.392	2.859E-11	.343
17	4.314E-12	.360	4.718E-11	.255	2.330E-11	.367
18	2.001E-11	.468	2.728E-11	.281	3.136E-11	.285
19	1.510E-11	.408	2.184E-11	.364	1.787E-11	.332
20	9.888E-12	.529	2.286E-11	.334	3.120E-11	.287
21	1.469E-11	.372	2.273E-11	.354	3.264E-11	.272
22	1.550E-11	.339	1.618E-11	.330	2.276E-11	.307
23	1.178E-11	.359	1.327E-11	.333	1.612E-11	.325
24	5.259E-12	.505	2.757E-11	.295	1.686E-11	.343
25	9.525E-12	.547	1.815E-11	.383	2.625E-11	.370
26	2.743E-11	.409	1.765E-11	.410	2.286E-12	.632
27	1.745E-11	.425	3.521E-11	.316	1.474E-11	.451
28	2.361E-12	.788	1.735E-11	.437	1.483E-11	.557
29	1.802E-11	.414	1.741E-11	.481	1.043E-11	.483
30	1.655E-11	.391	1.340E-11	.384	1.745E-11	.403
31	1.874E-11	.348	1.475E-11	.460	2.426E-11	.462
32	1.690E-11	.345	9.230E-12	.501	2.368E-11	.383
33	1.170E-11	.445	1.477E-11	.447	2.280E-11	.397
34	1.533E-11	.408	2.237E-11	.443	2.136E-11	.505
35	1.365E-11	.423	1.113E-11	.619	2.366E-11	.473
36	1.843E-11	.497	1.959E-11	.681	1.359E-11	.499
37	7.094E-12	.359	8.670E-12	.386	5.460E-12	.341

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	6.837E-12	.295	2.294E-11	.315	1.755E-11	.255
2	1.150E-11	.223	3.449E-11	.240	1.911E-11	.224
3	2.016E-11	.246	1.978E-11	.322	2.763E-11	.221
4	1.457E-11	.299	3.237E-11	.226	2.910E-11	.249
5	1.823E-11	.246	4.398E-11	.194	2.778E-11	.209
6	1.670E-11	.301	2.053E-11	.262	2.194E-11	.222
7	1.457E-11	.340	3.943E-11	.229	1.486E-11	.281
8	1.671E-11	.309	2.457E-11	.304	2.513E-11	.282
9	1.486E-11	.290	2.614E-11	.277	2.292E-11	.281
10	1.974E-11	.360	1.736E-11	.280	1.724E-11	.309
11	1.288E-11	.354	3.104E-11	.273	1.403E-11	.324
12	1.339E-11	.490	1.376E-11	.353	1.559E-11	.433
13	1.266E-11	.440	2.732E-11	.337	1.889E-11	.434
14	2.792E-11	.313	2.247E-11	.294	1.617E-11	.416
15	1.007E-11	.474	3.901E-11	.303	1.504E-11	.379
16	1.532E-11	.368	2.319E-11	.341	1.107E-11	.452
17	1.231E-11	.430	1.522E-11	.349	7.822E-12	.483
18	5.722E-13	.590	1.740E-11	.318	1.989E-11	.356
19	1.099E-11	.575	2.219E-11	.313	5.408E-12	.418
20	6.921E-12	.567	1.838E-11	.410	3.140E-11	.325
21	7.083E-12	.425	1.920E-11	.370	2.791E-11	.323
22	3.741E-12	.864	1.982E-11	.281	1.632E-11	.317
23	5.485E-12	.486	2.870E-11	.269	8.732E-12	.393
24	6.509E-12	.650	2.709E-11	.293	8.423E-12	.540
25	1.003E-11	.527	2.205E-11	.353	6.594E-12	.546
26	3.855E-12	.866	2.168E-11	.349	7.094E-12	.539
27	0.	0.000	2.195E-11	.364	1.631E-11	.432
28	5.916E-12	.604	1.598E-11	.555	1.531E-11	.461
29	0.	0.000	2.987E-11	.315	1.553E-11	.439
30	2.316E-12	1.000	3.361E-11	.292	8.249E-12	.635
31	1.128E-11	.504	1.546E-11	.406	1.816E-11	.460
32	1.262E-11	.482	1.248E-11	.445	1.846E-11	.370
33	1.901E-12	1.000	2.420E-11	.321	1.932E-11	.430
34	1.846E-12	.892	1.822E-11	.389	1.436E-11	.426
35	4.619E-12	1.000	3.749E-11	.302	4.587E-11	.747
36	7.443E-13	1.000	3.902E-11	.653	6.171E-12	1.000
37	3.465E-13	.621	7.588E-12	.426	4.299E-12	.393

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	1.530E-11	.278	2.538E-11	.240	1.053E-11	.244
2	1.559E-11	.278	2.095E-11	.259	9.150E-12	.300
3	1.8[illegible]5E-11	.382	3.413E-11	.288	5.498E-12	.455
4	2.365E-11	.290	2.994E-11	.237	1.262E-11	.350
5	2.186E-11	.303	2.309E-11	.251	1.942E-11	.303
6	2.199E-11	.315	2.673E-11	.199	1.857E-11	.397
7	2.391E-11	.299	2.986E-11	.248	1.417E-11	.291
8	2.125E-11	.289	3.159E-11	.283	1.678E-11	.356
9	8.059E-12	.446	1.434E-11	.398	2.168E-11	.321
10	1.755E-11	.318	3.312E-11	.271	1.684E-11	.386
11	1.194E-11	.439	2.289E-11	.378	1.113E-11	.548
12	1.056E-11	.449	1.233E-11	.419	5.876E-12	.631
13	1.057E-11	.475	1.637E-11	.370	9.306E-12	.559
14	1.134E-11	.395	2.321E-11	.305	1.058E-11	.544
15	5.669E-12	.740	2.018E-11	.314	4.888E-12	.649
16	5.123E-12	.497	2.464E-11	.428	9.472E-12	.502
17	1.576E-11	.419	2.526E-11	.354	3.732E-12	.603
18	1.659E-11	.394	1.838E-11	.380	3.334E-12	.678
19	5.050E-12	.409	3.429E-11	.256	1.346E-11	.520
20	8.278E-12	.529	1.239E-11	.504	5.682E-12	.572
21	7.048E-12	.528	2.010E-11	.329	5.442E-12	.544
22	5.369E-12	.456	1.490E-11	.300	3.825E-12	.358
23	2.355E-12	.948	1.664E-11	.315	6.095E-12	.512
24	2.957E-12	.699	2.122E-11	.353	4.208E-12	.629
25	2.596E-12	.631	2.022E-11	.387	3.424E-12	.771
26	9.301E-12	.725	8.395E-12	.570	2.417E-12	.993
27	2.833E-12	.772	4.873E-12	.956	0.	0.000
28	5.228E-12	.744	2.853E-11	.416	0.	0.000
29	7.205E-12	.581	1.533E-11	.411	8.198E-12	.579
30	1.741E-12	.738	9.840E-12	.546	4.418E-12	.706
31	8.509E-12	.534	5.343E-12	.556	0.	0.000
32	5.221E-12	.683	3.265E-11	.280	3.032E-14	1.000
33	8.679E-12	.537	1.350E-11	.420	4.723E-12	.708
34	3.289E-13	1.000	1.826E-11	.449	4.993E-12	.712
35	6.179E-12	.705	1.386E-11	.518	3.182E-12	1.000
36	7.160E-13	1.000	1.009E-11	.689	0.	0.000
37	1.551E-12	.629	5.613E-12	.304	1.402E-12	.639

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SPINE

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.907E-11	.301	2.163E-11	.223	1.682E-11	.245
2	1.251E-11	.346	8.174E-12	.235	2.145E-11	.238
3	2.218E-11	.314	1.873E-11	.266	2.326E-11	.262
4	5.960E-12	.231	1.784E-11	.371	2.202E-11	.291
5	1.215E-11	.328	2.740E-11	.270	1.668E-11	.297
6	1.227E-11	.356	7.939E-12	.304	2.504E-11	.307
7	1.346E-11	.387	2.502E-11	.290	2.042E-11	.290
8	1.908E-11	.325	1.571E-11	.302	1.543E-11	.254
9	9.658E-12	.405	1.443E-11	.364	1.294E-11	.310
10	2.730E-11	.312	2.320E-11	.300	1.683E-11	.318
11	4.328E-12	.454	1.312E-11	.382	2.008E-11	.371
12	6.619E-12	.513	1.606E-11	.378	1.481E-11	.308
13	3.624E-12	.476	4.807E-12	.453	1.363E-11	.426
14	6.775E-12	.536	1.048E-11	.406	1.572E-11	.392
15	6.139E-12	.606	1.413E-11	.392	1.619E-11	.377
16	1.045E-11	.599	1.330E-11	.394	9.982E-12	.467
17	6.967E-12	.435	2.071E-11	.338	7.921E-12	.393
18	1.039E-11	.559	6.047E-12	.542	1.629E-11	.387
19	1.306E-11	.413	1.151E-11	.376	2.069E-11	.350
20	9.340E-12	.478	8.781E-12	.434	1.724E-11	.431
21	8.208E-12	.379	1.323E-11	.510	5.964E-12	.555
22	2.705E-12	.654	5.628E-12	.480	1.117E-11	.481
23	3.790E-12	.414	9.337E-12	.482	8.666E-12	.444
24	1.042E-11	.614	1.463E-11	.459	2.609E-11	.338
25	7.790E-12	.567	1.775E-12	.582	1.482E-11	.473
26	1.053E-11	.593	1.634E-11	.452	1.092E-12	.705
27	1.696E-11	.653	2.169E-11	.625	4.007E-12	1.000
28	5.489E-12	.736	9.633E-12	.507	2.177E-11	.422
29	2.352E-11	.343	7.995E-12	.495	1.462E-11	.440
30	1.417E-12	1.000	3.956E-12	.705	1.304E-11	.504
31	7.828E-12	.771	7.258E-12	.581	1.022E-11	.457
32	4.725E-12	.595	1.647E-11	.476	3.191E-12	.706
33	1.925E-11	.411	1.051E-11	.458	7.465E-12	.605
34	2.516E-12	1.000	8.438E-12	.585	2.476E-12	1.000
35	0.	0.000	0.	0.000	5.960E-12	.833
36	3.982E-12	1.000	2.289E-11	.473	1.070E-11	.778
37	4.165E-12	.409	3.064E-12	.442	2.964E-12	.440

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.765E-11	.248	2.655E-11	.259	2.079E-11	.272
2	2.624E-11	.258	1.341E-11	.222	2.275E-11	.303
3	3.436E-11	.263	2.663E-11	.258	2.288E-11	.353
4	3.059E-11	.236	2.866E-11	.252	2.349E-11	.257
5	2.858E-11	.247	1.703E-11	.250	1.772E-11	.262
6	2.276E-11	.277	2.385E-11	.256	2.068E-11	.294
7	3.833E-11	.266	1.778E-11	.259	1.942E-11	.236
8	2.234E-11	.258	2.756E-11	.389	2.459E-11	.268
9	1.619E-11	.313	1.449E-11	.356	2.327E-11	.252
10	2.234E-11	.284	1.558E-11	.311	3.468E-11	.300
11	2.742E-11	.295	1.643E-11	.353	2.329E-11	.334
12	2.139E-11	.356	1.413E-11	.389	9.345E-12	.351
13	1.755E-11	.306	5.126E-12	.599	1.377E-11	.377
14	9.174E-12	.371	1.485E-11	.305	1.915E-11	.302
15	8.197E-12	.484	2.192E-11	.331	2.655E-11	.312
16	4.940E-12	.592	1.212E-11	.515	2.299E-11	.317
17	8.131E-12	.492	1.018E-11	.384	8.192E-12	.513
18	2.377E-11	.319	1.647E-11	.342	2.074E-11	.348
19	1.899E-11	.313	1.868E-11	.337	1.704E-11	.421
20	2.210E-11	.458	7.838E-12	.462	1.559E-11	.399
21	3.084E-11	.267	1.042E-11	.417	2.682E-11	.296
22	2.566E-11	.300	1.956E-11	.322	1.696E-11	.378
23	1.931E-11	.265	2.504E-11	.303	2.035E-11	.338
24	1.729E-11	.387	5.660E-12	.442	1.660E-11	.388
25	2.349E-11	.375	9.384E-12	.470	1.161E-11	.433
26	2.986E-11	.365	2.359E-11	.483	1.462E-11	.444
27	1.875E-11	.442	1.454E-11	.413	1.699E-11	.443
28	1.603E-11	.435	2.027E-11	.425	6.753E-12	.606
29	1.734E-11	.406	1.278E-11	.452	1.698E-11	.460
30	2.133E-11	.498	1.659E-11	.602	1.079E-11	.450
31	2.997E-11	.354	1.867E-11	.416	6.238E-12	.761
32	1.175E-11	.405	1.957E-11	.475	1.175E-11	.482
33	2.389E-11	.317	2.571E-11	.336	1.444E-11	.438
34	2.953E-11	.304	9.531E-12	.576	1.299E-11	.499
35	2.318E-11	.389	2.219E-11	.812	7.070E-12	.705
36	1.166E-11	.612	6.136E-12	.703	1.832E-12	1.000
37	1.164E-11	.243	5.296E-12	.457	2.374E-12	.420

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.496E-11	.327	2.652E-11	.242	1.811E-11	.314
2	1.529E-11	.305	2.103E-11	.238	1.899E-11	.242
3	2.420E-11	.271	3.454E-11	.216	1.787E-11	.292
4	2.181E-11	.288	2.758E-11	.225	1.256E-11	.221
5	2.743E-11	.263	3.697E-11	.240	2.227E-11	.241
6	1.303E-11	.269	1.937E-11	.247	2.207E-11	.324
7	2.281E-11	.307	3.616E-11	.222	2.220E-11	.282
8	2.615E-11	.254	3.512E-11	.228	9.057E-12	.330
9	1.598E-11	.386	4.222E-11	.221	2.509E-11	.306
10	1.347E-11	.424	2.297E-11	.294	1.204E-11	.436
11	8.549E-12	.377	2.690E-11	.299	1.263E-11	.419
12	1.864E-11	.397	1.136E-11	.397	1.419E-11	.333
13	1.636E-11	.381	2.155E-11	.377	7.446E-12	.446
14	9.863E-12	.485	2.936E-11	.326	7.705E-12	.394
15	1.235E-11	.461	1.245E-11	.470	6.625E-12	.638
16	2.799E-11	.301	2.712E-11	.391	1.301E-11	.417
17	1.533E-11	.402	1.972E-11	.312	1.593E-11	.370
18	2.528E-11	.321	3.197E-11	.290	1.355E-11	.383
19	1.983E-11	.366	1.036E-11	.422	1.831E-11	.381
20	1.764E-11	.369	2.650E-11	.336	1.728E-11	.440
21	6.102E-12	.386	2.731E-11	.385	1.383E-11	.443
22	1.366E-11	.464	3.677E-11	.258	4.374E-12	.656
23	1.150E-11	.496	2.959E-11	.247	7.819E-12	.611
24	1.137E-11	.492	4.859E-11	.244	5.790E-12	.759
25	8.763E-12	.584	3.327E-11	.290	5.416E-12	.660
26	2.247E-11	.397	9.706E-12	.528	1.292E-12	.664
27	7.927E-12	.720	1.208E-11	.508	5.285E-12	.705
28	1.212E-11	.466	1.850E-11	.428	7.888E-12	.605
29	4.666E-12	.642	3.915E-11	.326	7.393E-12	.705
30	1.169E-11	.602	3.927E-11	.286	9.632E-12	.578
31	8.249E-12	.752	4.083E-11	.345	1.056E-11	.532
32	1.050E-11	.496	2.568E-11	.401	6.562E-12	.486
33	6.649E-12	.585	2.791E-11	.380	1.039E-11	.608
34	5.186E-12	.707	3.318E-11	.387	5.384E-12	.705
35	9.810E-12	.824	4.992E-11	.297	3.041E-12	1.000
36	2.164E-11	.680	1.937E-11	.393	0.	0.000
37	1.860E-12	.520	1.393E-11	.204	4.284E-12	.372

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.532E-11	.338	2.033E-11	.252	1.051E-11	.369
2	9.639E-12	.295	1.661E-11	.298	9.006E-12	.407
3	1.851E-11	.295	3.753E-11	.215	1.438E-11	.337
4	1.276E-11	.380	1.431E-11	.320	1.092E-11	.375
5	3.232E-11	.259	2.657E-11	.267	7.447E-12	.310
6	1.047E-11	.261	1.462E-11	.294	1.047E-11	.432
7	1.542E-11	.334	2.249E-11	.242	1.463E-11	.351
8	2.526E-11	.263	1.608E-11	.319	1.631E-11	.432
9	1.464E-11	.371	2.554E-11	.279	6.395E-12	.488
10	1.263E-11	.366	2.958E-11	.264	5.743E-12	.691
11	1.054E-11	.364	2.030E-11	.320	9.204E-12	.455
12	1.894E-11	.309	2.127E-11	.325	5.983E-12	.600
13	1.490E-11	.355	1.567E-11	.322	1.628E-12	.768
14	1.436E-11	.442	1.148E-11	.594	1.036E-11	.447
15	1.667E-11	.401	1.247E-11	.386	5.932E-12	.495
16	6.151E-12	.492	8.783E-12	.482	1.430E-12	.852
17	6.267E-12	.515	1.592E-11	.305	1.096E-12	.357
18	9.023E-12	.531	1.817E-11	.411	9.818E-12	.496
19	7.960E-12	.574	1.828E-11	.439	6.180E-12	.622
20	1.494E-12	.557	1.416E-11	.382	5.042E-12	.669
21	1.794E-11	.358	2.652E-11	.317	5.595E-12	.672
22	2.077E-11	.377	1.573E-11	.274	2.490E-12	.691
23	6.142E-12	.557	1.744E-11	.325	5.893E-12	.723
24	8.529E-12	.652	2.004E-11	.317	3.677E-12	.672
25	1.470E-11	.410	2.738E-11	.410	4.068E-12	.688
26	1.635E-11	.586	5.391E-12	.565	5.548E-12	.711
27	4.942E-12	.743	8.497E-12	.580	1.079E-11	.578
28	1.147E-11	.594	6.587E-12	.638	0.	0.000
29	9.078E-12	.581	1.689E-12	.991	2.070E-12	1.000
30	2.885E-12	.704	1.499E-11	.428	1.417E-11	.527
31	3.055E-12	.656	1.135E-11	.460	1.016E-11	.606
32	8.684E-12	.503	1.143E-11	.416	1.116E-11	.457
33	3.632E-12	1.000	1.904E-11	.405	2.525E-12	1.000
34	9.354E-14	.833	1.597E-11	.406	4.282E-12	.609
35	2.972E-12	1.000	2.128E-11	.352	2.997E-13	1.000
36	7.841E-12	1.000	7.443E-13	1.000	0.	0.000
37	1.922E-12	.565	1.037E-11	.380	2.117E-12	.524

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SKULL

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	7.402E-12	.310	9.091E-12	.418	9.310E-12	.501
2	2.038E-11	.318	8.984E-12	.426	8.478E-12	.317
3	7.143E-12	.476	1.303E-11	.324	1.157E-11	.410
4	1.209E-11	.452	7.913E-12	.321	8.942E-12	.387
5	2.427E-11	.322	1.191E-11	.400	1.161E-11	.438
6	5.938E-12	.362	1.199E-11	.414	5.725E-12	.426
7	9.430E-12	.389	1.503E-11	.326	9.964E-12	.401
8	1.135E-11	.360	1.100E-11	.315	1.211E-11	.343
9	3.072E-12	.524	1.159E-11	.404	1.565E-11	.471
10	6.203E-12	.485	1.433E-11	.379	1.052E-12	.520
11	3.302E-12	.434	1.203E-11	.453	8.281E-12	.489
12	6.333E-12	.589	1.044E-11	.520	4.922E-12	.698
13	4.724E-12	.675	4.605E-12	.393	5.289E-12	.448
14	4.288E-12	.703	1.195E-11	.481	5.255E-12	.409
15	4.833E-12	.753	5.611E-12	.621	5.729E-12	.483
16	7.837E-12	.661	7.533E-12	.579	2.736E-12	.672
17	3.415E-12	.905	2.075E-12	.732	8.406E-12	.446
18	2.309E-12	.844	1.979E-12	.684	1.624E-11	.519
19	3.688E-12	.551	1.429E-11	.396	1.320E-11	.494
20	5.722E-12	.593	2.709E-11	.381	3.766E-12	.508
21	7.866E-12	.391	1.550E-11	.405	3.936E-12	.487
22	1.174E-11	.484	1.138E-11	.447	1.217E-12	.695
23	7.746E-12	.609	1.073E-11	.462	6.606E-12	.474
24	2.684E-12	.715	1.913E-11	.350	1.234E-11	.467
25	1.738E-11	.459	4.625E-12	.706	1.320E-11	.546
26	5.163E-13	1.000	5.675E-12	.625	9.791E-12	.569
27	9.234E-12	.611	5.683E-12	.682	1.151E-11	.543
28	3.909E-12	.803	9.314E-12	.463	7.531E-12	.586
29	1.755E-11	.465	3.276E-12	1.000	1.168E-11	.484
30	9.268E-12	.552	5.151E-12	.710	6.943E-12	.649
31	3.656E-12	.707	1.102E-11	.540	4.450E-12	.760
32	4.870E-12	.706	5.344E-12	.665	7.361E-12	.575
33	1.251E-11	.496	1.873E-11	.477	7.569E-12	.725
34	2.955E-11	.687	1.891E-11	.505	1.364E-11	.446
35	1.354E-11	.473	1.262E-11	.489	2.311E-11	.353
36	1.638E-11	.600	1.919E-11	.960	2.032E-11	.783
37	7.490E-12	.298	7.789E-12	.288	4.829E-12	.373

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.647E-12	.456	4.223E-12	.362	6.338E-12	.304
2	2.997E-12	.363	1.294E-11	.290	6.692E-12	.315
3	2.103E-11	.338	1.490E-11	.279	1.048E-11	.406
4	2.381E-11	.321	8.234E-12	.346	1.011E-11	.336
5	7.745E-12	.461	2.521E-11	.317	1.055E-11	.377
6	2.173E-11	.274	8.819E-12	.424	1.335E-11	.275
7	9.233E-12	.316	2.632E-11	.285	1.757E-11	.372
8	2.466E-11	.302	2.440E-11	.307	5.917E-12	.454
9	1.500E-11	.499	1.569E-11	.369	2.032E-11	.341
10	6.017E-12	.441	1.047E-11	.502	1.123E-11	.511
11	8.090E-12	.495	1.793E-11	.358	9.909E-12	.491
12	7.588E-13	.378	1.269E-11	.467	1.919E-12	.632
13	6.819E-12	.663	5.105E-12	.599	1.601E-11	.455
14	6.830E-12	.593	9.393E-12	.392	7.811E-12	.531
15	4.400E-12	.593	1.139E-11	.449	7.088E-12	.542
16	9.035E-12	.664	5.303E-12	.446	8.859E-12	.565
17	1.057E-11	.404	1.245E-11	.550	1.433E-11	.463
18	2.787E-12	.505	6.090E-13	.635	1.402E-11	.445
19	2.543E-12	.490	1.126E-11	.497	1.531E-11	.467
20	4.293E-12	.538	4.296E-12	.612	1.051E-11	.484
21	8.521E-12	.497	1.221E-11	.457	5.273E-12	.730
22	1.833E-11	.346	1.441E-11	.553	5.640E-12	.380
23	1.167E-11	.397	1.101E-11	.457	2.270E-12	.499
24	1.300E-11	.556	1.681E-11	.417	4.538E-12	.684
25	7.553E-12	.573	6.000E-12	.586	6.288E-12	.496
26	5.460E-12	.666	1.699E-11	.450	1.655E-11	.573
27	1.479E-11	.467	3.232E-11	.346	7.004E-12	.710
28	2.182E-11	.547	1.444E-11	.542	1.030E-11	.581
29	9.106E-12	.516	1.785E-11	.387	1.451E-11	.604
30	7.379E-12	.673	9.904E-12	.529	1.704E-11	.431
31	1.006E-11	.462	1.729E-11	.491	6.408E-12	.578
32	1.121E-11	.514	1.809E-11	.429	0.	0.000
33	9.601E-12	.509	1.934E-11	.376	8.929E-12	.579
34	1.085E-11	.545	1.676E-11	.407	5.752E-12	.740
35	5.627E-12	.635	1.897E-11	.466	1.192E-11	.600
36	1.510E-11	.826	8.404E-13	1.000	3.581E-12	1.000
37	5.054E-12	.347	8.699E-12	.429	3.025E-12	.445

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.689E-11	.365	5.994E-12	.570	4.015E-12	.350
2	1.038E-11	.389	1.505E-11	.349	1.533E-11	.370
3	1.898E-11	.312	1.017E-11	.357	1.433E-11	.413
4	9.781E-12	.385	1.207E-11	.385	4.167E-12	.329
5	2.260E-11	.301	1.618E-11	.379	6.669E-12	.526
6	8.902E-12	.430	8.519E-12	.366	8.264E-12	.340
7	1.047E-11	.329	1.496E-11	.346	1.592E-11	.367
8	2.364E-11	.310	1.796E-11	.397	3.755E-12	.358
9	1.072E-11	.408	1.599E-11	.380	7.769E-12	.614
10	1.282E-11	.447	1.316E-11	.411	1.657E-11	.392
11	5.817E-12	.658	5.362E-12	.576	1.307E-11	.438
12	4.597E-12	.617	9.189E-12	.600	7.034E-13	.462
13	7.548E-12	.684	9.445E-12	.588	1.972E-12	.414
14	1.924E-12	.550	2.203E-12	.449	1.556E-12	.726
15	7.132E-12	.585	3.123E-12	.450	3.403E-12	.741
16	1.722E-11	.393	8.905E-12	.660	4.722E-12	.722
17	6.549E-12	.466	4.804E-12	.454	1.365E-12	.618
18	1.802E-12	.776	9.829E-12	.463	2.785E-12	.700
19	1.809E-11	.460	2.539E-12	.550	4.976E-12	.692
20	4.799E-12	.769	6.016E-12	.749	4.849E-12	.747
21	1.014E-11	.507	1.116E-11	.436	1.383E-12	.566
22	1.302E-11	.496	9.766E-12	.503	4.781E-12	.428
23	5.736E-12	.606	6.940E-12	.660	1.180E-11	.462
24	6.755E-12	.639	1.468E-11	.427	3.558E-14	.705
25	6.076E-12	.640	4.869E-12	.661	9.780E-12	.663
26	1.178E-11	.509	8.254E-12	.598	9.877E-12	.932
27	1.740E-11	.528	1.216E-11	.625	8.874E-12	.606
28	1.311E-11	.530	1.129E-11	.483	0.	0.000
29	1.133E-11	.455	1.823E-11	.374	8.378E-12	.608
30	1.038E-11	.454	1.094E-11	.527	3.387E-12	1.000
31	3.716E-12	1.000	4.856E-12	.699	6.298E-12	.706
32	4.196E-12	.717	7.359E-12	.590	7.224E-13	1.000
33	1.684E-11	.448	6.440E-12	.622	5.422E-12	.736
34	5.595E-12	.705	8.598E-12	.598	1.235E-11	.492
35	0.	0.000	7.962E-12	.642	2.316E-12	1.000
36	6.058E-12	1.000	3.765E-12	.816	0.	0.000
37	3.157E-12	.405	3.104E-12	.448	8.877E-12	.385

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	5.778E-12	.370	1.264E-11	.402	4.634E-12	.319
2	8.205E-12	.540	2.385E-11	.298	8.169E-12	.426
3	1.641E-11	.367	1.763E-11	.299	4.233E-12	.513
4	4.610E-12	.354	1.102E-11	.316	4.670E-12	.721
5	3.491E-12	.366	1.104E-11	.330	1.569E-12	.482
6	6.329E-12	.263	1.196E-11	.404	6.583E-12	.579
7	5.962E-12	.392	1.358E-11	.398	4.598E-12	.709
8	1.029E-11	.288	1.201E-11	.434	2.308E-12	.843
9	3.319E-12	.531	7.088E-12	.388	4.024E-12	.719
10	4.052E-12	.529	5.359E-12	.623	4.535E-12	.712
11	2.508E-12	.728	5.811E-12	.516	1.795E-12	.528
12	6.276E-12	.567	7.605E-12	.600	1.937E-13	1.000
13	1.846E-12	.576	8.093E-12	.569	7.338E-12	.782
14	5.890E-13	.653	4.239E-12	.752	1.092E-12	.649
15	3.789E-12	.647	3.041E-12	.913	0.	0.000
16	5.918E-12	.856	9.699E-12	.526	9.349E-12	.704
17	6.755E-12	.573	2.131E-11	.470	1.460E-12	.639
18	5.043E-12	.767	5.313E-12	.705	4.379E-14	1.000
19	5.103E-12	.686	7.192E-13	.612	2.978E-13	1.000
20	7.482E-12	.627	6.363E-12	.570	3.117E-13	1.000
21	3.865E-12	.727	6.916E-12	.555	0.	0.000
22	4.145E-12	.875	6.259E-12	.588	3.029E-12	1.000
23	4.037E-12	.701	3.965E-12	.531	4.263E-12	.653
24	7.390E-12	.555	1.451E-12	.746	0.	0.000
25	3.129E-12	.706	5.022E-12	.873	0.	0.000
26	8.607E-12	.579	1.647E-11	.459	0.	0.000
27	2.706E-12	1.000	4.419E-12	1.000	0.	0.000
28	3.275E-12	1.000	2.409E-12	1.000	0.	0.000
29	7.509E-13	1.000	6.331E-12	.588	0.	0.000
30	1.019E-11	.656	5.662E-12	.736	0.	0.000
31	5.021E-12	.717	1.479E-12	1.000	0.	0.000
32	3.072E-13	.957	2.470E-13	.726	2.807E-12	1.000
33	0.	0.000	2.722E-12	1.000	0.	0.000
34	9.870E-12	1.000	5.453E-12	.720	0.	0.000
35	9.354E-12	.613	5.836E-12	.573	0.	0.000
36	2.636E-12	1.000	3.102E-13	1.000	0.	0.000
37	1.021E-12	.771	4.116E-12	.370	1.318E-14	1.000

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RIBS

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.088E-11	.350	8.840E-12	.406	2.013E-11	.330
2	8.259E-12	.451	2.343E-11	.302	1.224E-11	.364
3	9.847E-12	.394	1.158E-11	.263	9.457E-12	.417
4	5.368E-12	.331	2.468E-11	.282	1.516E-11	.274
5	8.949E-12	.362	1.973E-11	.386	9.408E-12	.309
6	6.726E-12	.349	2.345E-11	.298	1.130E-11	.439
7	1.045E-11	.455	1.551E-11	.317	1.602E-11	.291
8	8.145E-12	.512	1.358E-11	.287	9.435E-12	.309
9	7.532E-12	.515	9.159E-12	.466	1.109E-11	.347
10	4.657E-12	.635	1.782E-11	.291	6.889E-12	.455
11	1.758E-11	.382	5.522E-12	.471	1.195E-11	.411
12	2.974E-12	.928	9.312E-12	.445	1.859E-11	.433
13	4.974E-12	.614	8.585E-12	.488	7.352E-12	.584
14	8.629E-12	.505	3.305E-12	.519	7.598E-12	.525
15	4.130E-12	.891	1.195E-11	.526	9.959E-12	.500
16	1.059E-11	.489	7.682E-12	.509	1.010E-12	.537
17	1.899E-12	.564	1.234E-11	.446	7.162E-12	.550
18	5.164E-12	.660	1.324E-11	.575	5.629E-12	.416
19	9.115E-12	.585	2.334E-11	.331	1.212E-11	.475
20	7.903E-12	.632	1.818E-11	.403	1.171E-11	.479
21	5.212E-13	.902	1.166E-11	.501	5.776E-12	.532
22	5.410E-12	.507	1.593E-11	.347	4.689E-12	.701
23	1.436E-12	.539	2.039E-11	.354	1.150E-11	.385
24	7.878E-12	.700	2.175E-11	.377	2.870E-12	.831
25	4.291E-12	.648	9.503E-12	.519	8.616E-12	.580
26	2.615E-12	.728	1.070E-11	.547	1.604E-13	1.000
27	6.838E-12	.706	1.136E-11	.513	1.935E-11	.554
28	9.159E-12	.579	1.299E-11	.543	1.970E-11	.511
29	2.752E-12	.792	1.220E-11	.454	1.144E-11	.528
30	8.085E-12	.706	9.555E-12	.522	6.425E-12	.804
31	7.637E-12	.599	1.806E-11	.416	1.612E-11	.608
32	2.681E-12	.995	1.853E-11	.357	7.211E-12	.502
33	5.009E-12	.707	3.118E-11	.381	1.307E-11	.445
34	1.845E-11	.381	3.560E-12	.906	1.066E-11	.489
35	0.	0.000	2.538E-11	.346	3.825E-12	.598
36	2.969E-12	1.000	8.874E-12	.574	7.933E-13	1.000
37	4.612E-12	.394	9.786E-12	.282	4.669E-12	.382

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.251E-11	.386	1.933E-11	.343	5.855E-12	.290
2	1.004E-11	.275	1.055E-11	.354	2.621E-11	.259
3	1.630E-11	.319	2.078E-11	.353	2.528E-11	.264
4	2.262E-11	.363	2.407E-11	.294	2.173E-11	.307
5	1.576E-11	.354	9.049E-12	.270	2.396E-11	.293
6	1.718E-11	.330	2.829E-11	.263	2.020E-11	.271
7	1.594E-11	.322	4.021E-11	.254	1.744E-11	.296
8	2.420E-11	.296	1.422E-11	.309	1.288E-11	.385
9	1.269E-11	.364	1.977E-11	.308	2.560E-11	.288
10	1.918E-11	.379	1.824E-11	.318	1.472E-11	.382
11	1.642E-11	.348	6.085E-12	.546	1.365E-11	.376
12	1.938E-11	.380	2.815E-11	.336	3.107E-12	.390
13	1.639E-11	.473	4.152E-12	.426	7.901E-12	.581
14	1.019E-11	.460	1.434E-11	.367	1.122E-11	.442
15	1.927E-11	.339	4.847E-12	.366	7.796E-12	.337
16	2.268E-12	.614	1.832E-11	.441	1.558E-11	.393
17	1.139E-11	.453	1.285E-11	.441	1.762E-11	.464
18	1.065E-11	.417	9.826E-12	.533	1.061E-11	.426
19	1.215E-11	.463	1.035E-11	.400	1.549E-11	.483
20	9.136E-12	.519	2.242E-11	.351	1.402E-11	.390
21	1.428E-11	.347	2.164E-11	.321	3.401E-11	.255
22	1.834E-11	.330	1.751E-11	.310	2.146E-11	.317
23	1.344E-11	.394	9.966E-12	.360	1.725E-11	.353
24	4.900E-12	.629	1.547E-11	.503	1.806E-11	.393
25	1.608E-11	.509	3.001E-11	.335	1.704E-11	.379
26	7.806E-12	.675	1.263E-11	.483	2.449E-11	.360
27	7.001E-12	.667	5.528E-12	.683	7.478E-12	.577
28	2.112E-11	.372	1.490E-11	.475	7.162E-12	.624
29	1.148E-11	.469	1.035E-11	.552	1.666E-11	.417
30	2.044E-11	.379	5.640E-12	.728	2.968E-11	.382
31	1.739E-11	.422	2.281E-11	.412	3.456E-11	.351
32	1.436E-11	.469	1.147E-11	.456	3.141E-11	.311
33	1.732E-11	.393	2.155E-11	.384	2.445E-11	.368
34	2.706E-11	.643	1.101E-11	.496	3.157E-11	.344
35	1.383E-11	.499	1.923E-11	.430	3.450E-11	.378
36	2.960E-12	1.000	1.644E-11	.662	3.822E-11	.554
37	6.637E-12	.357	6.156E-12	.309	1.034E-11	.293

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.131E-11	.462	1.417E-11	.325	2.016E-11	.340
2	1.547E-11	.334	1.483E-11	.301	1.744E-11	.282
3	6.584E-12	.251	1.945E-11	.262	1.558E-11	.384
4	9.347E-12	.384	1.455E-11	.233	2.098E-11	.287
5	1.193E-11	.351	9.672E-12	.253	1.216E-11	.384
6	1.039E-11	.284	2.041E-11	.334	2.149E-11	.334
7	9.968E-12	.502	2.918E-11	.285	1.697E-11	.356
8	9.806E-12	.492	2.418E-11	.332	1.804E-11	.375
9	2.028E-11	.325	1.090E-11	.426	1.110E-11	.421
10	1.600E-11	.373	1.242E-11	.344	1.693E-11	.435
11	3.982E-12	.565	2.049E-11	.316	7.582E-12	.392
12	1.473E-11	.439	1.140E-11	.431	1.396E-11	.370
13	7.017E-12	.450	1.138E-11	.361	7.146E-12	.608
14	8.521E-12	.607	1.959E-11	.487	2.192E-11	.362
15	1.035E-11	.477	9.381E-12	.480	1.681E-11	.421
16	7.333E-12	.454	1.059E-11	.458	2.588E-12	.888
17	1.073E-11	.404	1.452E-11	.455	1.017E-11	.460
18	9.261E-12	.442	2.475E-11	.368	8.548E-12	.529
19	8.469E-12	.599	7.282E-12	.385	1.858E-11	.441
20	1.700E-12	.659	1.588E-11	.379	8.733E-12	.535
21	3.371E-12	.718	1.999E-11	.358	1.795E-11	.306
22	7.733E-12	.460	2.343E-11	.328	1.135E-11	.419
23	4.456E-12	.621	1.571E-11	.400	1.170E-11	.365
24	0.	0.000	1.581E-11	.405	6.969E-12	.533
25	1.371E-12	.706	8.586E-12	.499	1.773E-11	.413
26	2.542E-14	1.000	9.083E-12	.621	7.599E-12	.531
27	1.677E-11	.538	1.957E-11	.426	1.184E-11	.597
28	1.410E-11	.472	2.513E-12	.795	8.568E-12	.508
29	6.977E-12	.507	2.465E-11	.294	1.475E-11	.439
30	2.277E-12	1.000	2.558E-11	.360	2.353E-11	.338
31	5.540E-12	.829	2.991E-11	.363	9.638E-12	.509
32	7.677E-12	.773	1.473E-11	.392	2.650E-11	.357
33	9.063E-12	.503	3.471E-11	.336	1.185E-11	.461
34	8.257E-12	.591	1.989E-11	.414	5.992E-11	.682
35	2.185E-12	1.000	2.232E-11	.388	1.837E-11	.442
36	6.598E-13	1.000	8.694E-12	.724	9.078E-12	.575
37	1.785E-12	.622	7.423E-12	.290	7.520E-12	.303

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	1.742E-11	.366	2.011E-11	.301	8.265E-12	.366
2	1.261E-11	.393	3.080E-11	.269	7.295E-12	.511
3	1.079E-11	.416	2.305E-11	.331	5.006E-12	.489
4	9.534E-12	.364	1.718E-11	.364	9.721E-12	.395
5	1.066E-11	.373	1.852E-11	.303	9.963E-12	.482
6	3.968E-12	.388	6.419E-12	.273	4.634E-12	.326
7	9.566E-12	.353	2.051E-11	.279	1.099E-11	.426
8	1.925E-11	.353	1.974E-11	.371	1.398E-11	.403
9	1.219E-11	.485	1.709E-11	.357	1.163E-11	.401
10	6.752E-12	.429	6.193E-12	.528	8.271E-12	.450
11	5.742E-12	.705	1.444E-11	.392	5.129E-12	.686
12	8.610E-12	.408	7.634E-12	.410	5.643E-12	.610
13	3.285E-12	.524	1.588E-11	.484	4.192E-12	.542
14	4.419E-12	.442	5.522E-12	.700	1.499E-12	.891
15	2.073E-11	.386	1.287E-11	.388	1.601E-13	1.000
16	1.788E-11	.366	1.263E-11	.446	3.490E-12	.654
17	1.190E-11	.489	5.735E-12	.478	1.945E-12	.820
18	6.089E-12	.652	1.979E-11	.396	2.582E-12	.987
19	1.054E-11	.539	1.630E-11	.440	2.343E-12	.778
20	4.243E-12	.489	9.657E-12	.445	3.033E-12	.582
21	5.730E-13	.566	1.334E-11	.570	5.143E-12	.714
22	1.078E-11	.394	9.515E-12	.443	1.081E-12	.708
23	5.404E-12	.660	6.317E-12	.496	1.981E-12	.658
24	3.257E-12	.807	7.641E-12	.582	2.828E-12	1.000
25	7.892E-12	.622	1.235E-12	.853	3.220E-12	.683
26	0.	0.000	1.392E-11	.446	2.105E-12	1.000
27	5.032E-12	.703	1.431E-11	.503	4.052E-12	1.000
28	2.507E-12	1.000	3.909E-12	.733	3.569E-12	.706
29	1.004E-11	.458	1.319E-11	.447	1.066E-11	.631
30	7.417E-12	.553	1.288E-11	.438	0.	0.000
31	1.350E-11	.808	3.216E-12	.792	0.	0.000
32	2.080E-11	.749	9.249E-12	.499	6.823E-12	.574
33	4.873E-12	.697	4.542E-12	.721	3.822E-14	1.000
34	2.966E-12	1.000	1.794E-11	.361	2.122E-13	1.000
35	2.143E-11	.400	5.399E-12	.708	2.622E-12	.785
36	1.293E-11	.594	2.535E-12	1.000	2.637E-12	1.000
37	4.881E-12	.386	4.124E-12	.371	8.984E-13	.841

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SCAPULA

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.249E-11	.367	1.487E-11	.419	2.302E-12	.278
2	8.622E-12	.383	1.170E-11	.323	1.202E-11	.381
3	9.875E-12	.397	1.838E-11	.326	2.555E-11	.313
4	1.395E-11	.272	1.140E-11	.293	9.013E-12	.442
5	1.281E-11	.351	1.712E-11	.351	8.384E-12	.449
6	6.333E-12	.472	1.631E-11	.300	1.133E-11	.315
7	1.032E-11	.401	2.350E-11	.281	6.006E-12	.307
8	1.510E-11	.358	1.906E-11	.328	1.490E-11	.391
9	1.222E-11	.380	4.322E-12	.443	1.064E-11	.379
10	1.139E-11	.463	1.334E-11	.366	1.032E-11	.435
11	1.450E-11	.405	1.163E-11	.392	3.422E-12	.586
12	4.355E-12	.769	3.820E-12	.427	2.898E-12	.481
13	3.234E-12	.599	1.997E-12	.764	2.635E-12	.477
14	6.765E-12	.479	1.422E-11	.469	8.276E-12	.583
15	5.158E-12	.665	8.857E-12	.452	9.666E-12	.508
16	5.684E-12	.593	8.288E-12	.514	3.486E-12	.632
17	1.105E-12	.604	5.082E-12	.575	3.634E-12	.666
18	4.830E-13	.657	1.394E-11	.445	1.275E-11	.507
19	5.322E-12	.642	9.076E-12	.480	6.253E-13	.929
20	1.924E-12	.763	1.768E-11	.400	1.391E-11	.613
21	1.605E-12	.843	3.564E-12	.474	5.583E-12	.677
22	3.759E-12	.727	9.910E-12	.520	3.623E-12	.529
23	1.716E-12	.624	9.351E-12	.448	5.877E-12	.718
24	1.317E-11	.459	1.490E-11	.494	6.649E-13	1.000
25	1.206E-12	.708	6.873E-12	.678	4.392E-13	1.000
26	3.682E-12	1.000	3.162E-12	.787	1.997E-12	.985
27	8.710E-12	.603	7.433E-12	.712	0.	0.000
28	3.464E-12	1.000	1.146E-11	.519	8.440E-12	.602
29	1.367E-11	.579	3.037E-11	.332	3.798E-12	1.000
30	1.068E-11	.580	7.915E-12	.558	5.475E-12	.719
31	2.512E-12	1.000	1.273E-11	.525	1.119E-11	.528
32	5.209E-12	.723	1.437E-11	.498	8.068E-12	.535
33	3.040E-12	1.000	1.209E-11	.517	6.046E-12	.577
34	5.053E-12	.690	9.663E-12	.557	5.108E-12	.708
35	4.912E-12	.785	3.751E-11	.894	0.	0.000
36	0.	0.000	4.449E-14	.721	0.	0.000
37	2.068E-13	.831	8.093E-12	.286	1.544E-12	.679

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.180E-11	.403	1.714E-11	.318	1.920E-11	.347
2	2.425E-11	.337	8.022E-12	.444	1.582E-11	.318
3	1.698E-11	.319	2.991E-11	.305	1.220E-11	.351
4	1.231E-11	.401	1.745E-11	.331	1.605E-11	.302
5	1.825E-11	.306	2.039E-11	.307	1.463E-11	.361
6	2.980E-11	.260	2.709E-11	.233	1.415E-11	.272
7	4.842E-12	.315	1.615E-11	.303	1.499E-11	.325
8	1.432E-11	.398	5.540E-12	.293	1.379E-11	.394
9	1.593E-11	.341	4.408E-12	.476	1.154E-11	.401
10	1.233E-11	.418	1.829E-11	.340	1.430E-11	.363
11	1.114E-11	.490	1.249E-11	.468	1.048E-11	.429
12	1.083E-11	.563	7.087E-12	.600	8.920E-12	.496
13	8.652E-12	.486	1.172E-11	.486	4.372E-12	.773
14	5.071E-12	.477	1.788E-11	.413	4.232E-12	.523
15	9.463E-12	.426	4.619E-12	.743	1.028E-11	.545
16	1.550E-11	.445	1.067E-11	.528	7.049E-12	.512
17	9.847E-13	.572	1.087E-11	.387	8.488E-12	.503
18	7.187E-12	.534	3.425E-12	.646	1.729E-11	.382
19	1.209E-11	.462	6.715E-12	.463	8.543E-12	.539
20	5.613E-12	.511	1.211E-11	.535	7.667E-12	.633
21	1.621E-11	.312	9.475E-12	.370	1.738E-11	.353
22	2.161E-11	.375	6.297E-12	.474	1.784E-11	.323
23	1.354E-11	.338	1.821E-11	.369	1.429E-11	.508
24	5.315E-12	.675	5.285E-12	.629	1.587E-11	.525
25	5.050E-12	.523	3.307E-12	.419	8.543E-12	.635
26	8.673E-12	.589	1.184E-11	.544	3.311E-12	.985
27	1.943E-11	.560	1.196E-11	.513	5.894E-12	.709
28	6.452E-12	.712	4.683E-12	.794	4.600E-12	.757
29	5.534E-12	.703	1.442E-11	.450	8.017E-12	.597
30	1.360E-11	.529	2.885E-12	1.000	3.941E-12	.603
31	1.355E-11	.449	1.267E-11	.499	3.715E-12	1.000
32	3.313E-11	.298	8.211E-12	.751	7.381E-12	.587
33	9.759E-12	.477	5.237E-12	.610	3.067E-12	.994
34	1.612E-11	.427	2.290E-11	.359	8.962E-12	.531
35	2.461E-11	.362	1.880E-11	.364	8.825E-12	.578
36	1.317E-11	.499	3.400E-11	.479	3.426E-12	1.000
37	6.748E-12	.333	8.039E-12	.264	1.339E-12	.702

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	7.714E-12	.315	1.946E-11	.325	1.079E-11	.337
2	1.352E-11	.393	1.450E-11	.322	1.566E-11	.404
3	1.291E-11	.389	3.665E-11	.246	1.618E-11	.309
4	1.442E-11	.280	2.176E-11	.262	1.111E-11	.387
5	1.036E-11	.404	1.509E-11	.322	1.686E-11	.335
6	1.249E-11	.317	1.284E-11	.303	1.511E-11	.310
7	1.112E-11	.392	1.196E-11	.406	1.007E-11	.401
8	1.116E-11	.406	3.084E-11	.282	1.528E-11	.407
9	9.344E-12	.561	1.408E-11	.377	2.190E-11	.374
10	7.796E-12	.451	1.392E-11	.418	1.394E-11	.415
11	3.308E-12	.463	1.697E-11	.306	7.023E-12	.534
12	5.286E-12	.575	9.885E-12	.516	7.425E-12	.590
13	2.681E-12	.662	1.586E-11	.375	8.381E-12	.352
14	6.160E-12	.712	2.052E-12	.524	2.186E-12	.410
15	1.465E-11	.598	1.161E-11	.589	5.709E-12	.390
16	6.282E-12	.683	5.252E-12	.596	6.918E-12	.682
17	5.409E-12	.541	4.197E-12	.424	8.096E-12	.558
18	1.010E-11	.442	2.274E-11	.424	5.632E-12	.419
19	2.939E-12	.604	9.902E-12	.437	8.364E-12	.558
20	1.118E-13	.582	1.010E-11	.398	1.502E-11	.457
21	4.431E-12	.665	2.031E-11	.376	9.491E-12	.527
22	8.106E-12	.503	1.209E-11	.387	4.780E-12	.500
23	2.565E-12	.661	1.523E-11	.328	8.260E-12	.553
24	3.904E-12	.694	1.602E-11	.382	2.011E-12	.525
25	3.636E-12	.971	2.205E-11	.408	4.870E-12	.686
26	5.989E-12	.722	6.040E-12	.590	1.236E-11	.580
27	8.539E-12	.595	3.150E-11	.381	0.	0.000
28	8.678E-12	.578	2.068E-11	.394	6.336E-12	.705
29	4.972E-12	.710	1.559E-11	.435	1.503E-11	.460
30	0.	0.000	2.700E-11	.360	1.056E-11	.507
31	0.	0.000	1.122E-11	.670	1.652E-11	.434
32	7.021E-12	.586	3.113E-11	.323	1.363E-11	.426
33	1.802E-12	1.000	8.708E-12	.557	4.197E-12	.748
34	7.854E-12	.679	3.343E-11	.306	2.779E-12	1.000
35	4.441E-12	.869	5.285E-11	.568	2.213E-11	.465
36	0.	0.000	2.431E-11	.529	4.886E-11	.879
37	3.515E-12	.447	1.437E-11	.246	5.036E-12	.381

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	4.394E-12	.336	1.380E-11	.322	7.062E-12	.519
2	7.427E-12	.487	1.679E-11	.394	1.225E-12	.314
3	7.511E-12	.476	2.337E-11	.272	1.089E-11	.453
4	4.931E-12	.294	1.817E-11	.332	5.908E-12	.443
5	5.537E-12	.448	2.585E-11	.275	8.304E-12	.296
6	7.520E-12	.299	8.040E-12	.303	1.062E-11	.477
7	8.742E-12	.431	8.876E-12	.324	1.212E-11	.439
8	2.427E-12	.320	1.348E-11	.318	8.704E-12	.432
9	1.245E-11	.457	1.036E-11	.382	1.314E-11	.394
10	1.607E-12	.573	1.043E-11	.484	4.372E-12	.776
11	6.236E-12	.621	1.474E-11	.419	7.865E-12	.513
12	5.637E-12	.648	5.168E-12	.376	6.029E-13	.867
13	8.789E-12	.546	9.609E-12	.404	5.303E-12	.628
14	1.655E-12	.445	5.580E-12	.650	2.904E-12	.903
15	1.015E-11	.581	1.405E-11	.492	1.284E-12	.773
16	8.279E-12	.597	7.977E-12	.500	1.768E-14	1.000
17	1.554E-11	.455	6.065E-12	.631	4.692E-12	.544
18	2.797E-12	.615	1.005E-11	.394	2.014E-12	1.000
19	2.476E-12	.693	4.498E-12	.555	3.558E-13	.607
20	9.874E-13	.555	1.104E-11	.487	6.613E-12	.596
21	6.778E-12	.527	5.226E-12	.466	4.407E-12	.857
22	6.026E-12	.851	4.681E-12	.434	1.255E-12	.929
23	1.622E-13	.705	6.344E-12	.613	8.862E-14	1.000
24	4.236E-13	1.000	7.997E-12	.454	3.737E-13	1.000
25	0.	0.000	8.757E-12	.575	1.096E-12	.741
26	2.904E-12	.790	1.898E-11	.459	6.437E-12	.705
27	3.927E-12	1.000	1.195E-11	.526	2.107E-12	1.000
28	2.297E-12	1.000	3.337E-13	1.000	4.648E-12	.708
29	2.063E-12	1.000	1.121E-11	.456	1.585E-12	1.000
30	0.	0.000	7.718E-12	.581	1.406E-12	1.000
31	5.403E-12	.600	1.036E-11	.537	1.197E-13	1.000
32	4.103E-12	1.000	9.437E-12	.747	6.787E-12	.641
33	2.673E-12	1.000	1.921E-11	.371	2.937E-12	1.000
34	0.	0.000	1.264E-11	.599	0.	0.000
35	0.	0.000	1.631E-11	.415	5.198E-12	.722
36	0.	0.000	8.446E-12	.914	0.	0.000
37	2.557E-14	.705	8.928E-12	.270	1.023E-12	.719

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	3.864E-12	.398	1.224E-11	.368	1.379E-11	.327
2	7.090E-12	.523	3.327E-11	.244	1.088E-11	.286
3	9.378E-12	.384	1.484E-11	.228	1.861E-11	.291
4	1.178E-11	.405	2.509E-11	.275	7.479E-12	.286
5	1.905E-12	.342	2.632E-11	.232	1.262E-11	.342
6	3.414E-12	.340	2.035E-11	.347	1.398E-11	.323
7	6.185E-12	.558	1.329E-11	.403	1.310E-11	.284
8	1.087E-11	.429	1.317E-11	.301	1.467E-11	.364
9	5.727E-12	.652	1.704E-11	.347	1.644E-11	.328
10	1.637E-12	.606	3.640E-11	.251	1.809E-11	.451
11	5.019E-12	.700	1.851E-11	.375	7.628E-12	.495
12	5.323E-12	.671	1.524E-11	.383	1.253E-11	.391
13	4.372E-12	.502	1.260E-11	.480	9.051E-12	.402
14	4.624E-12	.825	1.663E-11	.372	1.319E-11	.420
15	3.317E-12	.996	9.471E-12	.547	8.796E-12	.539
16	4.775E-12	.899	1.073E-11	.440	2.358E-12	.547
17	0.	0.000	1.884E-11	.342	1.274E-12	.501
18	3.603E-12	.853	2.107E-11	.298	1.941E-11	.372
19	1.923E-12	.579	7.319E-12	.583	1.297E-11	.426
20	9.962E-13	.604	2.123E-11	.311	3.234E-13	.791
21	6.034E-12	.934	6.845E-12	.489	1.173E-12	.536
22	5.630E-13	.788	1.683E-11	.363	6.043E-12	.635
23	5.350E-14	.574	8.681E-12	.436	3.038E-12	.568
24	3.006E-12	.947	2.264E-11	.350	1.395E-12	.575
25	4.329E-12	.862	8.556E-12	.578	1.143E-11	.505
26	3.563E-12	.743	8.040E-12	.919	4.090E-12	.615
27	6.845E-12	.722	1.562E-11	.535	4.200E-12	.772
28	3.796E-12	.747	1.129E-11	.578	1.368E-11	.531
29	0.	0.000	1.365E-11	.508	5.582E-12	.601
30	1.203E-11	.598	0.	0.000	4.820E-12	.601
31	0.	0.000	1.150E-11	.449	1.433E-12	1.000
32	3.426E-12	1.000	7.350E-12	.518	7.362E-12	.608
33	6.735E-12	.707	5.315E-12	.686	5.179E-12	.723
34	5.005E-12	.707	8.518E-12	.578	0.	0.000
35	0.	0.000	1.255E-11	.446	0.	0.000
36	0.	0.000	0.	0.000	7.890E-12	.574
37	2.053E-12	.523	3.058E-12	.435	2.913E-12	.457

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	1.650E-11	.305	1.628E-11	.293	2.412E-11	.279
2	1.798E-11	.293	3.123E-11	.238	1.098E-11	.276
3	2.455E-11	.257	2.026E-11	.322	1.882E-11	.204
4	1.404E-11	.314	2.581E-11	.310	3.215E-11	.242
5	2.114E-11	.279	1.840E-11	.269	1.332E-11	.272
6	1.729E-11	.267	1.452E-11	.311	2.903E-11	.241
7	2.536E-11	.284	2.842E-11	.249	2.863E-11	.263
8	2.040E-11	.286	3.722E-11	.262	2.779E-11	.259
9	1.993E-11	.305	1.833E-11	.301	2.911E-11	.274
10	9.827E-12	.406	8.065E-12	.477	3.409E-11	.265
11	2.441E-11	.290	1.660E-11	.329	3.046E-11	.270
12	1.181E-11	.460	1.576E-11	.375	1.056E-11	.381
13	2.069E-11	.373	1.188E-11	.489	1.466E-11	.403
14	8.493E-12	.324	7.388E-12	.505	1.599E-11	.380
15	1.173E-11	.469	7.471E-12	.374	1.331E-11	.481
16	1.425E-11	.370	1.449E-11	.394	1.518E-11	.443
17	1.921E-11	.357	3.042E-11	.327	2.381E-11	.396
18	1.868E-11	.470	2.208E-11	.347	2.148E-11	.332
19	1.533E-11	.372	5.722E-12	.481	1.841E-11	.348
20	1.109E-11	.372	2.986E-11	.336	2.547E-11	.376
21	1.993E-11	.312	1.833E-11	.312	1.611E-11	.366
22	2.279E-11	.308	1.765E-11	.375	1.680E-11	.378
23	2.202E-11	.345	1.599E-11	.390	1.504E-11	.379
24	1.153E-11	.385	5.456E-12	.704	2.401E-11	.370
25	1.134E-11	.473	2.282E-11	.338	2.102E-11	.343
26	2.562E-11	.344	1.567E-11	.450	8.817E-12	.547
27	5.543E-12	.706	1.340E-11	.567	2.159E-11	.420
28	1.212E-11	.522	3.175E-11	.303	1.600E-11	.482
29	1.640E-11	.415	3.527E-11	.280	2.036E-11	.354
30	1.943E-11	.418	2.949E-11	.343	1.899E-11	.429
31	1.105E-11	.486	1.679E-11	.414	2.055E-11	.437
32	6.534E-12	.588	2.550E-11	.289	1.861E-11	.333
33	1.787E-11	.443	1.062E-11	.497	1.845E-11	.445
34	1.468E-11	.445	1.473E-11	.504	7.585E-12	.536
35	1.166E-11	.592	5.318E-12	.621	9.463E-12	.609
36	6.383E-12	.707	4.013E-11	.573	8.789E-12	.574
37	5.802E-12	.335	5.301E-12	.348	1.238E-11	.221

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.397E-11	.240	2.105E-11	.268	1.843E-11	.265
2	1.230E-11	.332	2.038E-11	.247	2.828E-11	.259
3	1.121E-11	.270	2.616E-11	.260	2.465E-11	.275
4	1.118E-11	.249	2.536E-11	.241	1.477E-11	.306
5	1.586E-11	.359	3.226E-11	.242	2.560E-11	.288
6	2.243E-11	.269	2.262E-11	.299	2.119E-11	.273
7	2.081E-11	.236	2.544E-11	.280	2.468E-11	.264
8	1.858E-11	.385	3.900E-11	.228	1.822E-11	.324
9	9.869E-12	.416	2.111E-11	.359	1.392E-11	.357
10	9.531E-12	.425	2.068E-11	.295	2.276E-11	.307
11	5.051E-12	.443	3.133E-11	.275	1.139E-11	.412
12	1.210E-11	.409	1.575E-11	.337	2.177E-11	.320
13	7.912E-12	.495	2.515E-11	.300	1.581E-11	.434
14	4.869E-12	.839	1.716E-11	.405	2.116E-11	.368
15	4.331E-12	.725	1.296E-11	.441	9.408E-12	.516
16	1.510E-11	.465	1.227E-11	.338	1.491E-11	.407
17	1.834E-11	.380	2.674E-11	.303	2.428E-11	.349
18	6.544E-12	.543	1.624E-11	.337	1.942E-11	.450
19	8.232E-12	.538	2.337E-11	.338	2.092E-11	.373
20	6.501E-12	.695	1.425E-11	.405	1.010E-11	.383
21	1.070E-11	.507	1.402E-11	.350	1.163E-11	.444
22	2.010E-12	.525	1.694E-11	.342	1.741E-11	.292
23	1.098E-11	.509	2.511E-11	.316	2.289E-11	.330
24	7.166E-12	.521	2.553E-11	.296	1.543E-11	.385
25	5.021E-12	.694	1.514E-11	.451	8.308E-12	.477
26	1.581E-11	.458	2.038E-11	.434	6.410E-12	.598
27	8.360E-12	.585	1.545E-11	.526	1.082E-11	.625
28	2.545E-12	1.000	2.686E-11	.340	4.712E-12	.727
29	7.801E-12	.589	1.675E-11	.366	1.391E-11	.401
30	2.025E-12	1.000	2.594E-11	.425	7.247E-12	.597
31	1.123E-11	.548	2.031E-11	.333	1.802E-11	.460
32	1.757E-11	.373	2.080E-11	.319	9.170E-12	.457
33	2.579E-12	1.000	1.620E-11	.419	1.659E-11	.405
34	9.331E-12	.740	1.690E-11	.466	9.485E-12	.575
35	5.639E-12	.706	1.148E-11	.542	2.574E-12	1.000
36	8.014E-12	1.000	8.852E-12	.589	6.061E-12	1.000
37	2.158E-12	.504	5.441E-12	.325	9.378E-12	.258

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	5.857E-12	.236	1.122E-11	.280	1.175E-11	.267
2	1.845E-11	.344	2.102E-11	.271	8.365E-12	.308
3	3.273E-11	.296	2.024E-11	.222	9.517E-12	.323
4	1.486E-11	.286	1.217E-11	.245	2.369E-11	.354
5	1.668E-11	.336	2.465E-11	.264	1.668E-11	.347
6	2.150E-11	.277	2.669E-11	.246	1.242E-11	.305
7	2.059E-11	.289	2.907E-11	.257	1.523E-11	.262
8	1.723E-11	.362	1.892E-11	.375	1.426E-11	.407
9	8.865E-12	.357	2.667E-11	.276	6.385E-12	.571
10	4.948E-12	.359	1.091E-11	.430	6.672E-12	.488
11	1.294E-11	.355	1.371E-11	.404	8.394E-12	.528
12	1.240E-11	.455	7.370E-12	.426	2.914E-12	.856
13	1.591E-12	.469	1.021E-11	.423	8.891E-12	.499
14	6.367E-12	.452	7.903E-12	.292	5.731E-12	.790
15	7.924E-12	.575	8.320E-12	.486	4.714E-12	.641
16	1.451E-11	.449	1.346E-11	.420	5.285E-12	.672
17	1.432E-11	.393	1.271E-11	.366	1.702E-11	.438
18	9.213E-12	.655	1.592E-11	.333	1.003E-11	.513
19	1.584E-11	.415	1.847E-11	.393	9.637E-12	.450
20	1.091E-11	.534	1.064E-11	.439	5.732E-12	.648
21	5.075E-12	.669	1.765E-11	.333	9.175E-12	.532
22	8.065E-12	.380	1.454E-11	.360	5.344E-12	.682
23	5.533E-12	.480	1.172E-11	.480	9.086E-12	.603
24	1.009E-11	.514	1.674E-11	.324	5.362E-12	.623
25	2.358E-12	.715	1.392E-11	.393	5.183E-13	1.000
26	3.797E-12	.804	1.767E-11	.471	4.164E-12	1.000
27	1.702E-11	.417	2.463E-11	.380	5.865E-12	.755
28	9.426E-12	.582	1.615E-11	.515	2.069E-12	1.000
29	6.408E-12	.618	2.384E-11	.381	2.402E-12	.666
30	6.757E-12	.540	3.391E-11	.334	7.239E-12	.597
31	1.414E-11	.626	2.505E-11	.399	1.466E-12	1.000
32	6.926E-12	.616	1.064E-11	.416	6.685E-12	.499
33	9.758E-12	.597	2.233E-11	.406	5.178E-12	.705
34	2.256E-12	1.000	2.131E-11	.417	1.259E-11	1.000
35	1.014E-11	.498	2.668E-12	1.000	8.519E-12	.574
36	2.758E-12	1.000	1.836E-11	.850	2.553E-12	1.000
37	5.641E-12	.332	8.016E-12	.277	6.273E-13	.634

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ARM

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.336E-11	.437	5.042E-12	.343	1.085E-11	.387
2	6.912E-12	.321	8.416E-12	.421	9.409E-12	.378
3	1.443E-11	.280	2.072E-11	.300	8.813E-12	.337
4	3.223E-12	.352	1.864E-11	.320	1.510E-11	.352
5	1.318E-11	.373	1.422E-11	.377	5.971E-12	.378
6	9.629E-12	.444	1.664E-11	.411	1.381E-12	.371
7	1.161E-11	.394	1.899E-11	.370	7.436E-12	.484
8	7.641E-12	.417	2.145E-11	.363	1.184E-11	.491
9	1.597E-11	.435	6.593E-12	.397	5.919E-12	.583
10	6.057E-12	.498	9.559E-12	.329	9.148E-13	.485
11	6.091E-12	.445	1.786E-11	.386	1.177E-11	.454
12	1.173E-12	.350	8.607E-12	.467	1.414E-12	.563
13	2.182E-12	.758	1.595E-12	.605	2.670E-12	.817
14	1.691E-12	.583	1.407E-11	.514	2.545E-12	.599
15	4.734E-12	.892	2.071E-12	.507	2.744E-12	.950
16	8.061E-13	.928	3.271E-12	.714	6.035E-12	.839
17	6.082E-12	.580	1.070E-11	.501	2.829E-12	.680
18	7.450E-12	.629	8.308E-12	.587	3.865E-12	.457
19	2.286E-13	1.000	4.498E-12	.571	9.225E-12	.588
20	3.667E-12	.582	4.870E-12	.513	6.446E-12	.616
21	5.179E-12	.755	7.098E-12	.564	4.934E-12	.524
22	7.566E-12	.534	1.200E-11	.418	3.060E-12	.523
23	1.385E-12	.506	4.992E-12	.440	3.305E-12	.693
24	2.663E-12	.767	5.800E-12	.627	1.042E-12	.635
25	9.032E-12	.582	4.605E-12	.590	1.774E-12	.575
26	1.045E-11	.776	6.013E-12	.861	9.534E-14	1.000
27	0.	0.000	5.280E-12	.712	0.	0.000
28	3.132E-12	1.000	5.461E-12	.734	5.142E-12	.751
29	2.861E-12	.717	7.449E-12	.667	3.723E-12	1.000
30	2.788E-12	.907	5.820E-12	.698	6.689E-13	1.000
31	6.625E-12	1.000	1.808E-11	.471	5.615E-12	.707
32	9.944E-12	.609	1.264E-11	.456	2.754E-12	1.000
33	5.520E-12	.631	7.198E-12	.575	1.505E-13	.883
34	4.181E-12	1.000	1.975E-11	.440	7.145E-13	1.000
35	3.304E-12	1.000	1.483E-11	.503	7.742E-12	1.000
36	1.570E-11	.953	7.228E-12	.644	4.476E-12	.733
37	5.482E-12	.359	6.856E-12	.307	1.158E-12	.684

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPUNSE	FSD
1	8.356E-12	.326	1.358E-11	.338	7.097E-12	.328
2	6.764E-12	.320	1.272E-11	.328	1.419E-11	.318
3	1.157E-11	.372	1.656E-11	.296	1.519E-11	.300
4	1.415E-11	.275	2.071E-11	.337	7.452E-12	.362
5	9.243E-12	.416	1.676E-11	.316	8.783E-12	.317
6	1.890E-11	.344	7.583E-12	.399	1.257E-11	.349
7	7.648E-12	.324	1.372E-11	.300	1.555E-11	.299
8	2.173E-11	.317	8.550E-12	.305	1.748E-11	.432
9	1.366E-11	.411	1.681E-11	.391	1.695E-11	.323
10	2.032E-11	.365	1.862E-11	.359	1.266E-11	.541
11	1.123E-11	.442	8.759E-12	.492	1.426E-11	.417
12	1.313E-12	.553	5.991E-12	.668	1.529E-12	.350
13	7.677E-12	.665	4.427E-12	.872	8.215E-12	.534
14	4.325E-12	.487	8.197E-12	.541	8.461E-12	.534
15	1.023E-12	.794	2.751E-12	.720	6.685E-12	.659
16	1.233E-11	.543	6.875E-12	.416	1.084E-12	.543
17	9.279E-12	.673	4.758E-12	.502	1.331E-12	.740
18	1.435E-11	.470	9.519E-12	.499	1.315E-11	.445
19	1.245E-11	.556	7.260E-12	.476	3.994E-12	.636
20	2.266E-12	.919	6.498E-12	.684	1.138E-11	.597
21	1.839E-12	.699	1.250E-11	.474	3.360E-12	.536
22	5.652E-12	.417	9.915E-12	.413	1.247E-11	.388
23	3.652E-12	.660	4.566E-12	.579	4.824E-12	.508
24	3.814E-12	.594	3.217E-12	.849	6.170E-13	1.000
25	4.286E-12	.650	1.622E-11	.385	4.489E-12	.522
26	9.761E-12	.563	5.399E-12	.631	9.835E-13	.973
27	3.650E-12	1.000	6.477E-12	.680	1.309E-11	.522
28	1.812E-14	1.000	1.232E-11	.513	5.102E-12	.704
29	6.756E-12	.632	4.111E-12	.695	1.202E-11	.441
30	2.717E-12	.623	1.112E-11	.443	1.356E-11	.567
31	6.635E-12	.599	1.295E-11	.616	7.352E-12	.594
32	1.125E-11	.455	1.418E-11	.407	5.452E-12	.684
33	3.970E-12	.770	1.725E-11	.413	1.452E-11	.478
34	2.765E-12	1.000	1.058E-11	.523	2.265E-11	.470
35	3.322E-12	.798	2.544E-11	.486	1.225E-11	.631
36	3.937E-11	.555	1.672E-11	.482	2.972E-12	1.000
37	3.658E-12	.404	9.557E-12	.243	3.758E-12	.380

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	7.032E-12	.491	1.189E-11	.363	1.395E-11	.354
2	1.041E-11	.316	1.019E-11	.390	1.343E-11	.308
3	7.319E-12	.402	1.662E-11	.374	1.468E-11	.375
4	8.507E-12	.442	7.884E-12	.393	1.905E-11	.328
5	7.338E-12	.436	8.798E-12	.378	1.474E-11	.266
6	9.554E-12	.514	1.796E-11	.421	1.592E-11	.300
7	5.861E-12	.336	3.044E-11	.267	4.154E-12	.416
8	7.669E-12	.412	1.314E-11	.281	8.145E-12	.406
9	3.078E-12	.471	2.666E-11	.353	9.555E-12	.524
10	5.335E-12	.524	5.940E-12	.410	1.576E-11	.372
11	3.241E-13	.549	7.569E-12	.535	1.714E-11	.487
12	2.076E-12	.820	2.774E-12	.539	6.373E-12	.592
13	6.719E-13	.654	2.772E-12	.556	1.236E-12	.572
14	3.183E-13	.758	6.038E-12	.729	5.773E-12	.768
15	7.527E-13	.858	3.036E-12	.943	5.240E-12	.870
16	1.418E-12	.793	2.570E-12	.566	1.052E-11	.464
17	1.897E-12	.868	3.143E-12	.522	6.044E-12	.382
18	4.060E-12	.662	7.325E-12	.625	4.833E-12	.879
19	0.	0.000	1.144E-11	.582	8.693E-12	.538
20	3.775E-12	.758	4.766E-12	.543	1.544E-12	.636
21	4.055E-12	.660	4.253E-12	.618	4.591E-12	.658
22	1.209E-14	1.000	1.544E-12	.525	1.431E-11	.414
23	1.210E-12	.986	1.157E-11	.458	1.414E-11	.385
24	1.125E-13	1.000	2.559E-12	.722	1.969E-11	.395
25	0.	0.000	3.380E-12	.590	1.467E-11	.420
26	3.898E-13	1.000	3.958E-12	.830	1.863E-11	.459
27	6.074E-13	1.000	1.616E-11	.481	4.600E-12	.763
28	0.	0.000	3.175E-12	.891	1.006E-11	.611
29	7.195E-13	1.000	1.422E-11	.520	6.296E-12	.867
30	0.	0.000	5.334E-12	.600	1.295E-12	.787
31	0.	0.000	1.723E-12	.724	1.432E-11	.522
32	4.890E-12	.595	8.081E-12	.764	1.177E-11	.471
33	0.	0.000	1.559E-11	.410	1.391E-11	.445
34	2.802E-12	1.000	9.350E-12	.583	7.383E-12	.610
35	0.	0.000	1.199E-11	.474	4.888E-12	.692
36	0.	0.000	7.278E-13	1.000	7.443E-13	1.000
37	1.235E-12	.720	7.112E-12	.303	7.594E-12	.290

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RADIATION DOSE DEPOSITION IN THE ACTIVE MARROW OF REFERENCE MAN--ETC(U)
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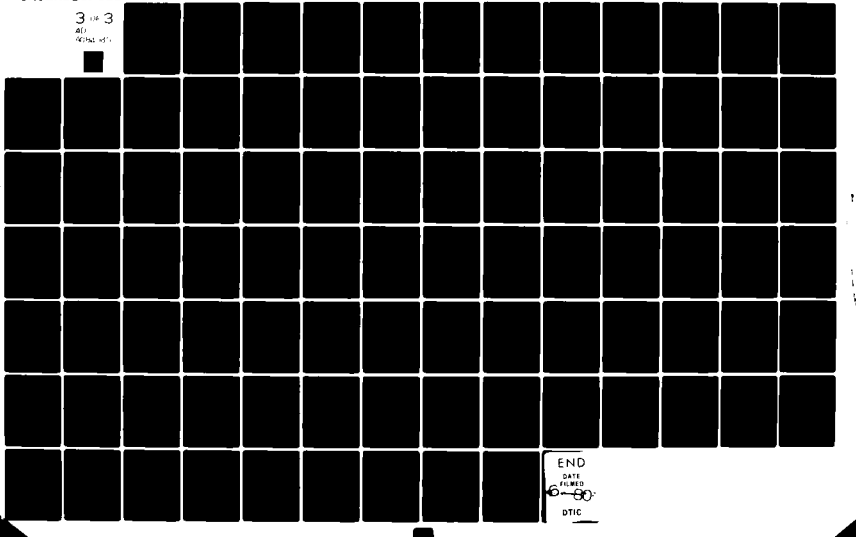
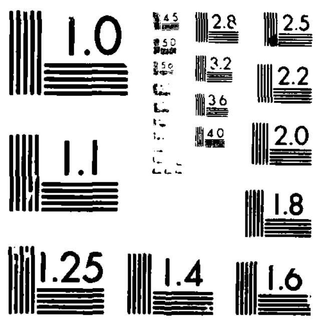
UNCLASSIFIED SAI-121-647-1 DNA-4442F NL





MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS 1963-A

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	8.289E-12	.435	7.846E-12	.323	8.712E-12	.535
2	7.806E-12	.391	5.201E-12	.383	9.951E-12	.476
3	3.375E-12	.387	1.335E-11	.397	6.529E-12	.379
4	9.358E-12	.332	1.036E-11	.374	1.445E-11	.349
5	4.100E-12	.357	1.177E-11	.325	3.860E-12	.725
6	5.674E-12	.398	7.922E-12	.446	1.635E-12	.532
7	9.293E-12	.421	7.385E-12	.490	7.400E-12	.529
8	3.815E-12	.636	1.428E-11	.393	2.147E-12	.660
9	1.323E-11	.427	8.516E-12	.495	4.431E-12	.461
10	7.924E-12	.497	7.344E-12	.330	5.641E-12	.608
11	3.478E-12	.629	1.538E-12	.469	5.448E-12	.504
12	8.170E-12	.521	1.243E-12	.519	4.674E-12	.869
13	2.105E-12	.617	5.827E-12	.572	1.554E-14	1.000
14	5.320E-13	.649	1.274E-11	.500	5.991E-13	.698
15	4.523E-12	.834	6.857E-12	.486	5.717E-13	.842
16	1.801E-13	.758	1.469E-12	.609	1.369E-12	.873
17	2.919E-12	.812	4.771E-12	.881	1.047E-12	.978
18	6.861E-12	.647	3.539E-12	.579	3.871E-12	.982
19	1.219E-12	.731	9.438E-13	.927	3.412E-13	.643
20	1.111E-12	.742	8.195E-13	.759	3.921E-12	1.000
21	8.221E-12	.594	7.221E-12	.597	1.487E-12	.657
22	2.059E-12	.851	4.169E-12	.863	2.563E-12	.906
23	3.289E-12	.632	5.387E-12	.571	0.	0.000
24	4.379E-12	1.000	3.680E-12	.740	6.223E-12	.667
25	4.950E-13	1.000	8.340E-13	.809	1.351E-12	.712
26	3.303E-12	.918	8.367E-12	.591	0.	0.000
27	1.030E-11	.677	4.754E-12	.705	3.074E-12	1.000
28	1.747E-14	1.000	2.132E-12	1.000	3.830E-12	.713
29	0.	0.000	1.828E-12	1.000	1.061E-12	1.000
30	4.357E-12	1.000	3.162E-12	.990	0.	0.000
31	0.	0.000	0.	0.000	2.783E-12	1.000
32	3.213E-12	1.000	9.475E-12	.514	0.	0.000
33	3.309E-12	.821	1.415E-11	.507	2.919E-12	1.000
34	0.	0.000	4.057E-12	.967	2.327E-12	1.000
35	0.	0.000	2.139E-11	.580	2.721E-12	1.000
36	1.510E-11	.807	7.443E-13	1.000	0.	0.000
37	1.022E-12	.765	6.228E-12	.317	3.371E-12	.458

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CLAVICLE

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	9.106E-12	.513	1.541E-11	.308	1.372E-11	.390
2	1.095E-11	.384	9.537E-12	.390	1.647E-11	.253
3	1.617E-11	.314	4.689E-12	.272	1.188E-11	.379
4	1.793E-11	.446	1.951E-11	.297	6.503E-12	.446
5	1.375E-11	.273	1.924E-11	.308	1.590E-11	.335
6	8.370E-12	.522	1.784E-11	.308	2.105E-11	.323
7	1.566E-11	.348	1.618E-11	.301	9.921E-12	.408
8	7.306E-12	.395	1.207E-11	.353	8.702E-12	.533
9	8.330E-12	.518	9.038E-12	.438	1.163E-11	.418
10	1.284E-11	.413	6.924E-12	.635	1.175E-11	.410
11	4.640E-12	.631	1.029E-11	.398	1.940E-11	.400
12	1.058E-11	.446	1.258E-11	.487	6.329E-12	.567
13	3.012E-12	.686	5.995E-12	.585	7.865E-13	.628
14	4.361E-12	.638	3.821E-12	.407	3.584E-12	.555
15	6.664E-13	.540	4.927E-12	.562	3.364E-12	.857
16	8.518E-12	.579	7.953E-12	.581	8.703E-12	.612
17	5.251E-12	.480	3.790E-12	.631	7.731E-12	.511
18	8.209E-13	.692	4.029E-12	.539	2.866E-12	.600
19	6.318E-12	.527	1.627E-11	.347	7.103E-12	.529
20	7.104E-12	.672	7.237E-12	.541	7.249E-12	.426
21	4.924E-12	.703	2.340E-11	.360	8.914E-12	.528
22	1.212E-11	.457	1.285E-11	.390	1.025E-11	.508
23	7.837E-12	.449	1.806E-11	.367	9.296E-12	.383
24	7.433E-12	.641	1.922E-11	.406	1.576E-11	.558
25	1.847E-11	.478	1.481E-11	.489	2.175E-12	.529
26	3.670E-13	1.000	1.036E-11	.565	3.564E-12	.685
27	0.	0.000	2.019E-11	.459	3.980E-12	1.000
28	1.046E-11	.589	2.534E-11	.371	2.212E-12	.942
29	2.677E-12	.995	1.648E-11	.443	7.159E-12	.581
30	1.281E-12	1.000	1.295E-11	.450	6.636E-12	.775
31	8.941E-12	.559	1.933E-11	.392	1.229E-11	.477
32	1.698E-11	.538	3.331E-11	.279	8.914E-12	.502
33	4.545E-12	.794	2.716E-11	.364	5.732E-13	1.000
34	4.078E-12	.683	1.573E-11	.490	1.945E-11	.353
35	5.084E-12	.709	2.245E-11	.560	1.520E-11	.432
36	2.428E-11	.848	5.645E-11	.686	2.646E-11	.658
37	6.807E-12	.310	1.567E-11	.210	7.399E-12	.293

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.050E-11	.397	1.110E-11	.441	2.286E-11	.300
2	1.858E-11	.367	2.167E-11	.314	1.124E-11	.324
3	1.658E-11	.361	2.745E-11	.295	1.781E-11	.350
4	1.609E-11	.265	1.226E-11	.292	1.903E-11	.339
5	9.302E-12	.360	1.787E-11	.281	1.341E-11	.318
6	1.933E-11	.303	1.517E-11	.325	1.847E-11	.347
7	1.359E-11	.396	8.753E-12	.470	2.620E-11	.276
8	2.128E-11	.376	8.760E-12	.319	2.523E-11	.259
9	1.222E-11	.364	2.450E-11	.288	2.386E-11	.320
10	9.115E-12	.491	2.263E-12	.422	2.158E-11	.333
11	1.113E-11	.494	7.345E-12	.434	1.568E-11	.386
12	3.332E-12	.718	5.805E-12	.617	1.594E-11	.434
13	5.258E-12	.648	2.813E-12	.870	4.942E-12	.671
14	5.003E-12	.589	5.288E-12	.481	5.740E-12	.619
15	6.241E-12	.514	5.414E-12	.648	1.164E-11	.551
16	9.439E-12	.466	1.155E-11	.413	1.926E-11	.398
17	5.720E-12	.623	9.697E-12	.411	1.157E-11	.486
18	6.168E-13	.923	5.310E-12	.518	1.516E-11	.561
19	1.255E-11	.499	1.113E-11	.523	4.931E-12	.438
20	1.327E-11	.569	3.959E-12	.464	2.783E-12	.787
21	1.333E-11	.424	5.640E-12	.621	2.131E-11	.387
22	9.091E-12	.453	2.324E-12	.416	1.217E-11	.358
23	5.901E-12	.497	1.220E-11	.344	6.717E-12	.417
24	3.499E-12	.742	1.768E-11	.352	2.876E-11	.333
25	7.478E-12	.808	1.674E-11	.479	8.108E-12	.656
26	1.039E-11	.679	2.378E-12	1.000	2.658E-11	.411
27	1.096E-11	.602	1.501E-11	.506	6.444E-12	.716
28	1.177E-11	.528	9.817E-12	.521	3.161E-11	.336
29	1.362E-11	.472	1.346E-11	.434	2.094E-11	.350
30	3.690E-12	.967	1.324E-11	.448	3.013E-11	.313
31	4.572E-12	.879	1.435E-11	.395	8.080E-12	.474
32	5.447E-12	.654	1.166E-11	.616	1.357E-11	.484
33	1.196E-11	.499	1.442E-11	.451	2.452E-11	.353
34	2.196E-11	.852	1.173E-11	.497	3.136E-11	.330
35	6.896E-12	.589	7.855E-12	.721	2.133E-11	.522
36	6.084E-11	.816	3.912E-12	.762	7.064E-11	.709
37	4.583E-12	.381	5.980E-12	.328	2.069E-11	.235

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	6.071E-12	.573	1.194E-11	.332	1.242E-11	.358
2	1.728E-11	.331	1.777E-11	.356	1.230E-11	.336
3	1.706E-11	.325	2.172E-11	.292	1.759E-11	.366
4	5.060E-12	.354	1.125E-11	.227	1.118E-11	.426
5	1.5 8E-11	.268	9.958E-12	.351	1.854E-11	.335
6	1.227E-11	.259	1.190E-11	.359	6.467E-12	.373
7	7.533E-12	.453	1.969E-11	.357	1.002E-11	.454
8	1.162E-11	.466	1.485E-11	.352	1.034E-11	.439
9	1.058E-11	.386	9.953E-12	.388	4.811E-12	.316
10	2.064E-11	.351	9.429E-12	.512	6.321E-12	.428
11	3.744E-12	.734	1.508E-11	.444	7.340E-12	.540
12	1.328E-11	.417	1.047E-11	.523	4.577E-12	.618
13	6.073E-12	.579	6.347E-12	.505	8.013E-12	.552
14	8.611E-13	.609	7.036E-12	.543	9.215E-12	.405
15	6.034E-12	.684	6.079E-12	.505	8.614E-12	.581
16	3.347E-12	.690	4.774E-13	.865	2.625E-12	.578
17	7.635E-12	.583	1.421E-11	.471	4.352E-12	.765
18	2.601E-12	.675	7.505E-12	.639	8.180E-12	.459
19	2.605E-13	.935	1.325E-11	.448	9.792E-12	.526
20	4.567E-12	.469	7.851E-12	.540	4.823E-12	.562
21	7.675E-12	.656	1.301E-11	.457	4.523E-12	.497
22	1.813E-12	.532	7.786E-12	.483	1.674E-11	.448
23	8.420E-12	.482	9.311E-12	.543	2.369E-12	.519
24	4.893E-12	.786	5.801E-12	.612	2.595E-11	.415
25	1.087E-11	.497	1.165E-11	.611	9.444E-12	.540
26	9.650E-12	.578	2.559E-12	1.000	1.031E-11	.525
27	7.450E-12	.713	7.388E-12	.626	8.249E-12	.591
28	2.831E-12	.793	6.714E-12	.595	5.896E-12	.677
29	6.262E-12	.598	0.	0.000	1.433E-11	.465
30	5.794E-12	.694	4.460E-12	.727	3.517E-12	.705
31	4.168E-12	.706	0.	0.000	1.023E-11	.521
32	6.579E-12	.575	5.503E-12	.722	1.988E-11	.454
33	5.639E-12	.633	1.384E-11	.513	9.730E-12	.500
34	0.	0.000	3.520E-12	.793	1.049E-11	.550
35	9.753E-12	.551	2.976E-12	1.000	7.826E-12	.641
36	2.966E-12	1.000	1.145E-11	1.000	3.363E-12	.813
37	1.838E-12	.586	3.806E-12	.394	7.109E-12	.311

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	5.295E-12	.634	1.044E-11	.423	8.731E-12	.468
2	1.339E-11	.332	1.123E-11	.384	5.337E-12	.465
3	1.970E-11	.338	8.474E-12	.434	8.570E-12	.560
4	1.282E-11	.331	1.294E-11	.393	3.465E-12	.338
5	1.009E-11	.467	9.470E-12	.398	1.049E-11	.415
6	9.777E-12	.422	4.531E-12	.450	4.102E-12	.391
7	1.725E-11	.307	7.273E-12	.326	1.727E-11	.359
8	1.489E-11	.454	5.717E-12	.416	4.031E-12	.424
9	9.285E-12	.395	2.391E-12	.545	6.864E-12	.518
10	5.717E-12	.424	1.487E-11	.367	5.269E-12	.809
11	5.068E-12	.443	8.752E-12	.544	2.213E-12	.736
12	5.200E-12	.665	6.472E-13	.728	5.454E-12	.690
13	5.956E-12	.641	7.752E-12	.608	7.056E-12	.643
14	7.130E-12	.633	8.194E-12	.456	8.778E-12	.535
15	6.789E-12	.608	4.812E-12	.464	2.847E-12	.858
16	5.950E-12	.770	1.717E-12	.896	1.111E-12	.670
17	6.166E-12	.638	3.289E-12	.559	2.574E-13	.830
18	5.709E-12	.576	1.679E-12	.557	5.507E-13	.706
19	2.775E-12	.949	4.157E-12	.855	8.173E-14	.763
20	3.906E-12	.764	3.382E-12	.759	3.862E-12	.877
21	1.193E-11	.536	1.052E-11	.488	1.427E-12	.718
22	1.115E-11	.453	3.178E-12	.613	0.	0.000
23	2.827E-12	.723	8.201E-14	1.000	3.119E-12	.734
24	5.720E-12	.646	4.081E-12	.862	1.420E-13	1.000
25	3.315E-12	.826	0.	0.000	4.921E-12	.888
26	3.895E-12	.952	7.047E-13	.968	0.	0.000
27	2.984E-12	1.000	6.541E-12	.707	3.046E-12	1.000
28	8.185E-12	.722	5.643E-14	1.000	2.731E-12	1.000
29	3.327E-12	.603	3.312E-12	.718	5.094E-12	.738
30	1.157E-11	.515	0.	0.000	0.	0.000
31	2.045E-12	.973	1.101E-11	.563	2.837E-12	1.000
32	2.416E-12	.794	1.029E-11	.551	3.482E-12	1.000
33	9.948E-12	.594	5.922E-12	.691	0.	0.000
34	9.683E-12	.530	2.319E-12	1.000	5.135E-12	.706
35	1.641E-11	.415	8.894E-12	.515	6.858E-13	1.000
36	4.680E-11	.795	3.168E-12	1.000	0.	0.000
37	5.945E-12	.593	8.533E-13	.881	1.612E-12	.674

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REFERENCE MAN

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.168E-11	.324	1.488E-11	.306	1.539E-11	.331
2	1.226E-11	.366	1.339E-11	.299	1.356E-11	.317
3	1.362E-11	.344	1.634E-11	.273	1.610E-11	.318
4	8.834E-12	.305	1.893E-11	.298	2.018E-11	.313
5	1.145E-11	.344	1.955E-11	.305	1.297E-11	.346
6	1.113E-11	.359	1.888E-11	.307	1.921E-11	.332
7	9.261E-12	.365	2.116E-11	.319	1.754E-11	.310
8	1.228E-11	.358	1.740E-11	.297	1.183E-11	.315
9	9.137E-12	.439	2.097E-11	.331	1.258E-11	.350
10	1.178E-11	.532	1.737E-11	.333	1.069E-11	.413
11	1.129E-11	.430	1.307E-11	.409	1.224E-11	.430
12	9.762E-12	.547	1.372E-11	.419	9.230E-12	.466
13	5.188E-12	.557	8.408E-12	.462	7.557E-12	.504
14	5.962E-12	.588	1.690E-11	.404	8.115E-12	.507
15	4.468E-12	.665	1.162E-11	.448	9.380E-12	.573
16	6.072E-12	.683	1.378E-11	.431	7.561E-12	.507
17	7.171E-12	.528	1.617E-11	.416	8.563E-12	.448
18	4.511E-12	.635	1.230E-11	.487	1.156E-11	.524
19	8.729E-12	.543	1.137E-11	.473	1.472E-11	.460
20	5.242E-12	.556	2.228E-11	.375	1.621E-11	.444
21	6.428E-12	.615	1.267E-11	.455	7.046E-12	.501
22	5.308E-12	.588	1.208E-11	.407	4.970E-12	.536
23	3.708E-12	.526	1.129E-11	.423	6.892E-12	.531
24	6.003E-12	.771	1.430E-11	.552	1.070E-11	.671
25	6.958E-12	.642	8.803E-12	.528	9.585E-12	.596
26	4.924E-12	.843	1.238E-11	.556	4.342E-12	.782
27	7.403E-12	.653	1.783E-11	.542	7.809E-12	.772
28	5.095E-12	.840	1.032E-11	.592	1.085E-11	.689
29	1.336E-11	.535	1.327E-11	.520	1.026E-11	.627
30	6.506E-12	.770	1.026E-11	.643	7.619E-12	.676
31	3.871E-12	.747	9.259E-12	.593	6.026E-12	.589
32	3.895E-12	.818	1.392E-11	.454	6.503E-12	.632
33	1.022E-11	.611	1.800E-11	.427	7.867E-12	.686
34	7.995E-12	.865	1.210E-11	.576	5.267E-12	.845
35	3.062E-12	.854	9.087E-12	.605	6.917E-12	.801
36	4.265E-12	.899	1.311E-11	.768	6.589E-12	.800
37	3.246E-12	.581	5.310E-12	.369	3.549E-12	.436

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	1.864E-11	.307	2.207E-11	.299	1.764E-11	.266
2	2.055E-11	.272	1.778E-11	.265	2.033E-11	.277
3	2.183E-11	.260	2.203E-11	.274	2.252E-11	.306
4	3.388E-11	.257	2.117E-11	.294	2.011E-11	.272
5	2.177E-11	.312	1.888E-11	.261	2.053E-11	.288
6	2.288E-11	.271	2.247E-11	.279	2.540E-11	.275
7	2.128E-11	.280	2.534E-11	.259	2.296E-11	.266
8	1.957E-11	.286	2.658E-11	.302	2.482E-11	.299
9	1.801E-11	.344	2.012E-11	.327	2.310E-11	.292
10	1.918E-11	.332	2.239E-11	.322	2.330E-11	.344
11	1.879E-11	.355	2.097E-11	.348	1.881E-11	.353
12	1.532E-11	.390	1.903E-11	.396	1.353E-11	.378
13	1.439E-11	.432	6.344E-12	.523	1.823E-11	.414
14	1.339E-11	.391	1.238E-11	.370	1.708E-11	.366
15	1.076E-11	.455	1.782E-11	.410	1.567E-11	.432
16	9.724E-12	.513	1.435E-11	.446	2.087E-11	.386
17	7.462E-12	.433	2.484E-11	.366	1.596E-11	.448
18	1.678E-11	.436	1.690E-11	.399	2.230E-11	.352
19	1.403E-11	.403	1.660E-11	.391	1.616E-11	.408
20	1.230E-11	.510	1.525E-11	.427	2.013E-11	.389
21	1.843E-11	.358	1.647E-11	.388	2.545E-11	.351
22	1.933E-11	.332	1.628E-11	.366	1.791E-11	.343
23	1.430E-11	.347	1.614E-11	.352	1.513E-11	.370
24	9.840E-12	.500	1.617E-11	.417	1.540E-11	.427
25	1.362E-11	.500	1.468E-11	.431	1.678E-11	.424
26	2.166E-11	.471	1.791E-11	.465	1.058E-11	.560
27	1.568E-11	.491	2.312E-11	.414	1.330E-11	.512
28	1.138E-11	.600	1.727E-11	.466	1.080E-11	.587
29	1.505E-11	.450	1.565E-11	.462	1.392E-11	.483
30	1.660E-11	.478	1.311E-11	.530	1.629E-11	.430
31	1.966E-11	.396	1.695E-11	.449	1.615E-11	.579
32	1.453E-11	.411	1.426E-11	.484	1.650E-11	.425
33	1.546E-11	.420	1.859E-11	.409	1.753E-11	.461
34	1.985E-11	.441	1.617E-11	.482	1.704E-11	.517
35	1.547E-11	.462	1.649E-11	.622	1.701E-11	.560
36	1.486E-11	.638	1.416E-11	.711	1.149E-11	.752
37	7.900E-12	.323	7.275E-12	.393	5.039E-12	.384

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.122E-11	.337	2.022E-11	.328	1.576E-11	.301
2	1.303E-11	.295	2.389E-11	.269	1.838E-11	.267
3	1.879E-11	.274	2.370E-11	.285	2.082E-11	.295
4	1.506E-11	.317	2.495E-11	.253	1.842E-11	.269
5	2.005E-11	.285	3.180E-11	.251	2.085E-11	.290
6	1.380E-11	.310	1.806E-11	.287	1.942E-11	.288
7	1.570E-11	.346	3.192E-11	.261	1.716E-11	.311
8	1.915E-11	.324	2.714E-11	.294	1.575E-11	.328
9	1.445E-11	.359	2.661E-11	.301	1.941E-11	.358
10	1.545E-11	.401	1.752E-11	.321	1.549E-11	.377
11	8.674E-12	.440	2.406E-11	.334	1.237E-11	.393
12	1.321E-11	.481	1.187E-11	.419	1.257E-11	.411
13	1.147E-11	.475	2.028E-11	.391	1.109E-11	.453
14	1.453E-11	.475	1.973E-11	.371	1.165E-11	.449
15	1.012E-11	.511	2.023E-11	.422	1.036E-11	.523
16	1.745E-11	.393	1.912E-11	.434	9.726E-12	.534
17	1.188E-11	.438	1.472E-11	.370	1.007E-11	.467
18	9.420E-12	.517	2.116E-11	.351	1.351E-11	.444
19	1.330E-11	.508	1.384E-11	.396	1.122E-11	.455
20	8.713E-12	.554	1.783E-11	.434	1.901E-11	.453
21	6.788E-12	.477	2.001E-11	.387	1.710E-11	.411
22	8.225E-12	.628	2.266E-11	.324	1.037E-11	.450
23	7.156E-12	.537	2.336E-11	.340	9.693E-12	.468
24	7.010E-12	.605	2.902E-11	.326	6.881E-12	.612
25	7.596E-12	.605	2.083E-11	.405	7.994E-12	.582
26	1.037E-11	.675	1.379E-11	.495	6.360E-12	.628
27	7.100E-12	.642	1.749E-11	.459	1.040E-11	.572
28	9.299E-12	.558	1.495E-11	.525	9.426E-12	.546
29	4.170E-12	.594	2.849E-11	.336	1.192E-11	.545
30	5.919E-12	.797	2.982E-11	.349	9.429E-12	.633
31	7.971E-12	.690	2.222E-11	.439	1.330E-11	.519
32	1.009E-11	.551	1.680E-11	.446	1.289E-11	.493
33	5.982E-12	.749	2.262E-11	.399	1.312E-11	.539
34	4.501E-12	.769	2.165E-11	.428	1.526E-11	.579
35	5.264E-12	.912	3.432E-11	.390	2.102E-11	.814
36	7.627E-12	.903	2.271E-11	.611	5.804E-12	.911
37	1.553E-12	.553	8.960E-12	.337	5.559E-12	.368

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	1.310E-11	.326	2.007E-11	.281	9.340E-12	.325
2	1.216E-11	.344	2.045E-11	.287	8.335E-12	.375
3	1.735E-11	.359	2.995E-11	.274	8.286E-12	.428
4	1.495E-11	.333	1.984E-11	.294	1.078E-11	.415
5	1.977E-11	.318	2.179E-11	.277	1.164E-11	.358
6	1.361E-11	.301	1.767E-11	.276	1.211E-11	.426
7	1.645E-11	.335	2.285E-11	.279	1.259E-11	.388
8	1.926E-11	.302	2.132E-11	.331	1.350E-11	.459
9	1.009E-11	.436	1.683E-11	.357	1.244E-11	.447
10	1.167E-11	.390	2.302E-11	.360	9.820E-12	.555
11	9.169E-12	.492	1.768E-11	.388	8.236E-12	.533
12	1.188E-11	.435	1.284E-11	.420	4.743E-12	.694
13	9.252E-12	.468	1.414E-11	.405	5.926E-12	.657
14	9.156E-12	.460	1.372E-11	.508	7.576E-12	.595
15	1.038E-11	.581	1.376E-11	.441	3.767E-12	.654
16	7.248E-12	.541	1.492E-11	.472	5.661E-12	.683
17	1.103E-11	.485	1.796E-11	.395	2.948E-12	.562
18	1.056E-11	.536	1.571E-11	.439	4.824E-12	.715
19	6.621E-12	.534	2.037E-11	.415	7.298E-12	.646
20	5.379E-12	.555	1.133E-11	.477	4.511E-12	.674
21	9.075E-12	.517	1.830E-11	.394	4.695E-12	.628
22	1.030E-11	.505	1.256E-11	.369	2.911E-12	.627
23	4.003E-12	.736	1.299E-11	.401	5.040E-12	.638
24	5.371E-12	.690	1.550E-11	.437	3.198E-12	.714
25	6.480E-12	.588	1.684E-11	.524	2.900E-12	.743
26	9.545E-12	.675	9.901E-12	.539	3.133E-12	.882
27	4.376E-12	.786	7.920E-12	.757	3.909E-12	.745
28	6.434E-12	.772	1.358E-11	.640	7.823E-13	.778
29	6.704E-12	.646	9.736E-12	.620	4.912E-12	.762
30	4.066E-12	.690	1.159E-11	.528	5.967E-12	.650
31	6.812E-12	.636	7.304E-12	.605	3.046E-12	.724
32	7.078E-12	.695	1.724E-11	.436	4.880E-12	.762
33	5.391E-12	.742	1.325E-11	.526	2.824E-12	.863
34	1.982E-12	.941	1.522E-11	.488	3.650E-12	.732
35	7.141E-12	.735	1.381E-11	.512	2.140E-12	.941
36	5.291E-12	.949	5.331E-12	.878	3.660E-13	1.000
37	2.069E-12	.599	6.802E-12	.348	1.365E-12	.675

AZIMUTHAL AND POLAR ANGLE-DIFFERENTIAL DOSE

DEPOSITION FACTORS

Total Dose Deposition From Incident Neutron Fluence (n-t)

PELVIS

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	2.315E-10*	5.975E-10	2.716E-10
2	1.626E-10	4.952E-10	2.423E-10
3	1.489E-10	3.919E-10	2.446E-10
4	1.661E-10	3.571E-10	2.210E-10
5	2.265E-10	3.348E-10	2.156E-10
6	1.541E-10	4.064E-10	2.568E-10
7	1.812E-10	3.840E-10	2.008E-10
8	8.612E-11	3.325E-10	1.524E-10
9	6.721E-11	3.142E-10	1.749E-10
10	1.059E-10	3.357E-10	1.479E-10
11	1.089E-10	3.456E-10	1.259E-10
12	1.012E-10	3.093E-10	9.114E-11
13	7.330E-11	2.486E-10	1.359E-10
14	6.257E-11	2.174E-10	8.585E-11
15	5.907E-11	1.959E-10	3.351E-11
16	8.724E-11	1.061E-10	5.306E-11
17	5.037E-11	1.117E-10	1.098E-10
18	3.569E-11	8.718E-11	7.061E-11
19	8.766E-12	5.794E-11	5.689E-11
20	9.923E-12	6.757E-11	4.768E-11
21	1.511E-11	3.081E-11	1.556E-11
22	5.477E-12	2.260E-11	1.474E-12
23	3.411E-12	1.149E-11	4.927E-12
24	4.109E-12	9.631E-12	2.818E-12
25	3.706E-12	2.469E-11	6.198E-12
26	2.990E-12	1.428E-11	6.692E-12
27	0.	2.317E-11	8.194E-12
28	4.288E-12	9.798E-12	1.697E-12
29	9.247E-12	1.917E-11	7.813E-12
30	8.347E-12	2.110E-11	4.934E-12
31	0.	1.015E-11	0.
32	2.212E-12	1.756E-11	8.384E-12
33	5.578E-12	2.649E-11	8.077E-12
34	2.624E-12	1.505E-11	3.092E-12
35	2.509E-12	5.324E-12	3.914E-12
36	0.	5.941E-12	5.178E-12
37	1.013E-12	4.242E-12	3.517E-12

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	4.162E-10	5.728E-10	4.655E-10
2	4.105E-10	5.019E-10	4.040E-10
3	3.590E-10	4.244E-10	4.387E-10
4	5.197E-10	4.929E-10	4.665E-10
5	5.560E-10	4.281E-10	4.426E-10
6	4.817E-10	4.956E-10	5.999E-10
7	4.366E-10	4.529E-10	3.621E-10
8	3.272E-10	4.337E-10	2.773E-10
9	4.109E-10	4.186E-10	3.970E-10
10	3.186E-10	2.982E-10	3.788E-10
11	3.594E-10	3.353E-10	3.515E-10
12	2.986E-10	3.345E-10	2.993E-10
13	2.840E-10	2.802E-10	2.640E-10
14	2.357E-10	2.986E-10	2.687E-10
15	2.629E-10	2.472E-10	2.148E-10
16	1.690E-10	1.619E-10	1.578E-10
17	1.573E-10	2.052E-10	1.244E-10
18	1.149E-10	1.767E-10	1.702E-10
19	7.396E-11	1.149E-10	1.207E-10
20	1.125E-10	1.581E-10	1.709E-10
21	4.843E-11	6.602E-11	7.359E-11
22	2.694E-11	1.855E-11	2.561E-11
23	1.688E-11	1.641E-11	1.642E-11
24	1.181E-11	2.900E-11	1.686E-11
25	1.331E-11	3.176E-11	2.625E-11
26	2.945E-11	1.765E-11	3.261E-12
27	4.025E-11	3.574E-11	1.474E-11
28	1.906E-11	1.735E-11	1.483E-11
29	1.802E-11	2.463E-11	1.043E-11
30	1.655E-11	3.303E-11	1.745E-11
31	2.664E-11	1.786E-11	2.426E-11
32	2.172E-11	9.230E-12	2.368E-11
33	1.170E-11	2.032E-11	2.280E-11
34	1.533E-11	3.027E-11	2.136E-11
35	1.365E-11	1.358E-11	2.366E-11
36	1.843E-11	1.959E-11	1.359E-11
37	7.405E-12	9.059E-12	5.771E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.127E-10	5.495E-10	4.450E-10
2	2.472E-10	6.772E-10	3.513E-10
3	2.644E-10	4.892E-10	3.577E-10
4	2.240E-10	4.444E-10	4.484E-10
5	2.501E-10	5.419E-10	4.453E-10
6	1.838E-10	5.250E-10	3.460E-10
7	2.816E-10	5.770E-10	4.577E-10
8	1.721E-10	4.164E-10	4.646E-10
9	1.498E-10	5.123E-10	2.888E-10
10	2.004E-10	3.952E-10	3.006E-10
11	1.364E-10	4.501E-10	2.331E-10
12	1.536E-10	3.975E-10	3.076E-10
13	1.091E-10	4.116E-10	2.834E-10
14	7.856E-11	4.610E-10	2.585E-10
15	6.490E-11	3.273E-10	1.809E-10
16	4.275E-11	2.490E-10	1.304E-10
17	5.423E-11	1.791E-10	1.215E-10
18	2.329E-11	2.793E-10	1.083E-10
19	2.218E-11	1.759E-10	1.009E-10
20	1.023E-11	2.172E-10	3.914E-11
21	7.577E-12	7.214E-11	6.008E-11
22	3.741E-12	2.964E-11	2.235E-11
23	5.609E-12	5.739E-11	8.913E-12
24	7.226E-12	3.713E-11	8.423E-12
25	1.003E-11	2.511E-11	6.769E-12
26	3.855E-12	2.291E-11	7.094E-12
27	0.	2.312E-11	1.631E-11
28	5.916E-12	1.598E-11	1.531E-11
29	0.	2.987E-11	1.562E-11
30	2.316E-12	4.482E-11	8.249E-12
31	1.128E-11	1.881E-11	1.816E-11
32	1.262E-11	1.504E-11	2.345E-11
33	1.901E-12	2.864E-11	1.932E-11
34	1.846E-12	2.288E-11	1.436E-11
35	4.619E-12	3.749E-11	4.587E-11
36	7.443E-13	4.401E-11	6.171E-12
37	3.465E-13	8.524E-12	4.377E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	2.925E-10	5.420E-10	2.449E-10
2	2.713E-10	4.745E-10	1.843E-10
3	2.519E-10	4.905E-10	2.161E-10
4	2.429E-10	5.003E-10	1.637E-10
5	2.367E-10	4.305E-10	1.516E-10
6	2.186E-10	4.790E-10	1.967E-10
7	2.453E-10	4.612E-10	2.169E-10
8	2.240E-10	4.188E-10	1.867E-10
9	1.988E-10	3.761E-10	1.341E-10
10	1.150E-10	4.057E-10	1.333E-10
11	1.622E-10	3.172E-10	1.265E-10
12	1.535E-10	3.019E-10	9.102E-11
13	1.054E-10	2.136E-10	1.318E-10
14	9.913E-11	2.387E-10	9.600E-11
15	7.028E-11	2.625E-10	6.763E-11
16	6.244E-11	2.115E-10	4.686E-11
17	6.533E-11	1.643E-10	2.811E-11
18	4.044E-11	1.727E-10	1.129E-11
19	6.794E-11	1.177E-10	2.645E-11
20	2.110E-11	8.933E-11	2.467E-11
21	7.313E-12	3.452E-11	1.681E-11
22	5.369E-12	2.601E-11	4.389E-12
23	2.355E-12	2.842E-11	6.891E-12
24	4.132E-12	2.136E-11	4.208E-12
25	2.596E-12	2.022E-11	3.424E-12
26	9.301E-12	8.395E-12	2.417E-12
27	2.833E-12	4.873E-12	0.
28	5.228E-12	2.853E-11	2.564E-12
29	7.205E-12	1.533E-11	8.198E-12
30	4.242E-12	1.016E-11	4.418E-12
31	8.509E-12	5.343E-12	0.
32	5.221E-12	4.037E-11	3.032E-14
33	8.679E-12	1.350E-11	4.723E-12
34	3.289E-13	2.077E-11	4.993E-12
35	6.179E-12	1.386E-11	3.182E-12
36	7.160E-13	1.009E-11	0.
37	1.551E-12	5.925E-12	1.636E-12

(n-t)

SPINE

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	2.962E-10	3.956E-10	3.698E-10
2	2.442E-10	3.349E-10	3.277E-10
3	2.459E-10	4.073E-10	3.240E-10
4	2.385E-10	3.354E-10	1.994E-10
5	2.633E-10	3.193E-10	3.392E-10
6	3.266E-10	2.873E-10	3.020E-10
7	2.108E-10	2.654E-10	2.120E-10
8	1.854E-10	3.120E-10	2.658E-10
9	1.451E-10	3.105E-10	2.403E-10
10	2.038E-10	2.763E-10	2.461E-10
11	2.000E-10	1.834E-10	2.066E-10
12	1.222E-10	2.247E-10	2.092E-10
13	6.760E-11	1.715E-10	1.839E-10
14	9.187E-11	2.251E-10	1.186E-10
15	1.020E-10	1.502E-10	7.438E-11
16	2.715E-11	5.053E-11	6.772E-11
17	4.239E-11	8.764E-11	7.623E-11
18	4.136E-11	8.341E-11	6.231E-11
19	4.705E-11	1.122E-10	4.503E-11
20	1.012E-11	2.115E-11	3.556E-11
21	8.287E-12	4.323E-11	1.646E-11
22	9.679E-12	5.628E-12	1.130E-11
23	3.986E-12	1.052E-11	8.969E-12
24	1.042E-11	1.463E-11	2.995E-11
25	1.111E-11	1.775E-12	1.482E-11
26	1.053E-11	1.634E-11	1.092E-12
27	1.696E-11	2.169E-11	4.007E-12
28	5.489E-12	9.633E-12	2.249E-11
29	2.352E-11	7.995E-12	1.462E-11
30	1.417E-12	3.956E-12	1.304E-11
31	7.828E-12	7.258E-12	1.022E-11
32	4.725E-12	1.647E-11	3.191E-12
33	1.925E-11	1.051E-11	7.465E-12
34	2.516E-12	8.438E-12	2.476E-12
35	0.	0.	5.960E-12
36	3.982E-12	2.289E-11	1.070E-11
37	4.243E-12	3.688E-12	3.120E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	5.562E-10	5.477E-10	3.037E-10
2	5.827E-10	5.859E-10	3.935E-10
3	4.583E-10	3.613E-10	3.331E-10
4	5.817E-10	5.031E-10	3.282E-10
5	4.922E-10	4.054E-10	3.419E-10
6	4.793E-10	4.168E-10	3.977E-10
7	5.258E-10	3.859E-10	2.884E-10
8	4.897E-10	4.065E-10	2.393E-10
9	3.632E-10	3.084E-10	3.335E-10
10	3.879E-10	2.317E-10	3.087E-10
11	3.312E-10	2.517E-10	2.271E-10
12	3.910E-10	2.281E-10	2.372E-10
13	3.207E-10	2.459E-10	1.906E-10
14	3.359E-10	2.424E-10	1.444E-10
15	3.943E-10	2.012E-10	1.256E-10
16	2.522E-10	1.603E-10	7.190E-11
17	2.154E-10	1.571E-10	1.822E-11
18	1.497E-10	8.846E-11	9.553E-11
19	1.550E-10	1.716E-10	8.927E-11
20	1.323E-10	9.231E-11	5.777E-11
21	9.004E-11	2.905E-11	3.111E-11
22	4.714E-11	2.772E-11	1.696E-11
23	2.964E-11	3.610E-11	2.035E-11
24	2.525E-11	5.660E-12	1.060E-11
25	2.559E-11	1.697E-11	1.161E-11
26	3.379E-11	2.359E-11	1.462E-11
27	1.875E-11	1.454E-11	1.699E-11
28	1.603E-11	2.027E-11	6.753E-12
29	1.734E-11	1.688E-11	1.698E-11
30	2.396E-11	1.659E-11	1.079E-11
31	3.432E-11	1.867E-11	6.238E-12
32	1.175E-11	1.957E-11	1.175E-11
33	2.389E-11	2.571E-11	1.444E-11
34	2.953E-11	9.531E-12	1.299E-11
35	2.318E-11	2.541E-11	7.070E-12
36	1.166E-11	6.136E-12	1.832E-12
37	1.281E-11	5.452E-12	2.452E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.481E-10	6.575E-10	2.782E-10
2	3.873E-10	7.162E-10	3.345E-10
3	3.826E-10	4.998E-10	2.286E-10
4	3.807E-10	6.522E-10	2.702E-10
5	3.198E-10	5.682E-10	2.921E-10
6	3.340E-10	5.885E-10	2.780E-10
7	2.709E-10	5.474E-10	2.871E-10
8	3.083E-10	5.481E-10	2.492E-10
9	3.201E-10	5.747E-10	2.725E-10
10	2.916E-10	3.927E-10	1.720E-10
11	1.946E-10	5.604E-10	2.136E-10
12	2.611E-10	3.796E-10	1.706E-10
13	2.261E-10	3.104E-10	1.167E-10
14	1.578E-10	3.725E-10	6.850E-11
15	1.699E-10	4.026E-10	1.664E-10
16	2.104E-10	3.674E-10	7.280E-11
17	8.918E-11	2.266E-10	2.420E-11
18	8.727E-11	1.734E-10	9.693E-11
19	1.394E-10	2.448E-10	5.366E-11
20	6.779E-11	1.864E-10	4.057E-11
21	1.915E-11	1.514E-10	1.392E-11
22	2.131E-11	7.634E-11	4.478E-12
23	1.286E-11	3.780E-11	7.819E-12
24	1.231E-11	5.380E-11	5.790E-12
25	8.952E-12	3.347E-11	5.416E-12
26	2.257E-11	1.482E-11	2.959E-12
27	7.927E-12	1.400E-11	5.285E-12
28	1.580E-11	1.875E-11	7.888E-12
29	4.666E-12	3.959E-11	7.393E-12
30	1.169E-11	5.026E-11	9.632E-12
31	8.249E-12	4.304E-11	1.056E-11
32	1.050E-11	2.880E-11	6.562E-12
33	6.649E-12	3.454E-11	1.039E-11
34	5.186E-12	3.721E-11	5.384E-12
35	9.810E-12	4.992E-11	3.041E-12
36	2.164E-11	1.937E-11	0.
37	2.172E-12	1.549E-11	4.440E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	2.619E-10	6.648E-10	1.955E-10
2	2.798E-10	4.497E-10	2.057E-10
3	2.399E-10	6.273E-10	1.368E-10
4	2.754E-10	5.384E-10	1.135E-10
5	2.548E-10	5.157E-10	1.319E-10
6	2.048E-10	5.992E-10	1.619E-10
7	2.245E-10	4.834E-10	1.239E-10
8	2.355E-10	4.822E-10	1.444E-10
9	1.717E-10	5.728E-10	1.071E-10
10	1.994E-10	4.535E-10	1.246E-10
11	1.460E-10	4.340E-10	8.119E-11
12	2.090E-10	4.882E-10	1.367E-10
13	1.222E-10	3.186E-10	8.799E-11
14	1.469E-10	2.304E-10	4.246E-11
15	1.358E-10	2.893E-10	5.152E-11
16	4.487E-11	1.929E-10	3.120E-11
17	3.722E-11	1.769E-10	2.931E-11
18	5.408E-11	2.188E-10	3.446E-11
19	3.996E-11	1.387E-10	6.180E-12
20	2.038E-11	1.406E-10	3.548E-11
21	1.927E-11	6.735E-11	7.630E-12
22	2.077E-11	3.746E-11	6.776E-12
23	6.246E-12	2.323E-11	5.997E-12
24	8.895E-12	3.434E-11	3.677E-12
25	1.470E-11	4.062E-11	4.068E-12
26	1.635E-11	5.391E-12	5.548E-12
27	4.942E-12	1.914E-11	1.079E-11
28	1.147E-11	6.701E-12	0.
29	9.078E-12	3.738E-12	2.070E-12
30	2.885E-12	1.657E-11	1.417E-11
31	3.055E-12	1.582E-11	1.016E-11
32	8.684E-12	1.143E-11	1.116E-11
33	3.632E-12	1.904E-11	2.525E-12
34	9.354E-14	1.597E-11	4.282E-12
35	2.972E-12	2.128E-11	2.997E-13
36	7.841E-12	1.092E-11	0.
37	2.000E-12	1.131E-11	2.195E-12

(n-t)

SKULL

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	6.865E-10	6.987E-10	4.797E-10
2	5.226E-10	5.603E-10	4.308E-10
3	4.988E-10	4.860E-10	4.346E-10
4	5.763E-10	4.883E-10	4.150E-10
5	4.275E-10	5.257E-10	3.972E-10
6	4.085E-10	4.829E-10	3.578E-10
7	4.712E-10	5.052E-10	4.185E-10
8	4.288E-10	4.699E-10	3.612E-10
9	3.709E-10	4.642E-10	4.141E-10
10	4.886E-10	4.715E-10	4.479E-10
11	3.442E-10	4.219E-10	3.330E-10
12	3.351E-10	4.160E-10	2.680E-10
13	3.593E-10	3.849E-10	3.503E-10
14	2.363E-10	4.214E-10	2.742E-10
15	3.005E-10	3.518E-10	3.401E-10
16	2.312E-10	4.050E-10	2.747E-10
17	2.451E-10	2.506E-10	1.526E-10
18	1.798E-10	1.507E-10	1.899E-10
19	2.708E-10	2.880E-10	1.877E-10
20	1.257E-10	3.012E-10	5.239E-11
21	1.353E-10	1.864E-10	5.229E-11
22	5.890E-11	8.011E-11	2.773E-11
23	5.427E-11	3.364E-11	1.855E-11
24	1.387E-11	3.677E-11	1.919E-11
25	2.185E-11	1.824E-11	1.446E-11
26	5.918E-12	9.093E-12	1.174E-11
27	1.160E-11	1.503E-11	1.250E-11
28	6.217E-12	1.027E-11	7.669E-12
29	2.759E-11	7.140E-12	1.168E-11
30	9.424E-12	9.990E-12	6.943E-12
31	8.590E-12	1.102E-11	4.601E-12
32	5.441E-12	5.422E-12	7.361E-12
33	1.535E-11	2.113E-11	1.311E-11
34	2.968E-11	1.934E-11	1.364E-11
35	1.354E-11	1.262E-11	2.311E-11
36	1.638E-11	1.919E-11	2.032E-11
37	8.894E-12	9.349E-12	5.297E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	4.368E-10	6.382E-10	4.482E-10
2	5.822E-10	6.781E-10	4.734E-10
3	4.962E-10	5.601E-10	4.034E-10
4	5.224E-10	6.041E-10	4.384E-10
5	4.042E-10	5.166E-10	5.212E-10
6	5.289E-10	6.192E-10	4.119E-10
7	4.350E-10	4.857E-10	4.389E-10
8	5.307E-10	4.708E-10	3.769E-10
9	4.311E-10	5.039E-10	3.494E-10
10	4.277E-10	4.286E-10	3.227E-10
11	3.494E-10	5.446E-10	2.889E-10
12	2.154E-10	4.236E-10	2.724E-10
13	4.158E-10	4.405E-10	3.314E-10
14	2.469E-10	3.812E-10	2.179E-10
15	3.601E-10	3.514E-10	2.796E-10
16	2.592E-10	3.723E-10	2.091E-10
17	3.078E-10	2.776E-10	1.491E-10
18	2.140E-10	2.940E-10	1.594E-10
19	2.205E-10	3.285E-10	1.482E-10
20	1.313E-10	2.206E-10	1.879E-10
21	1.022E-10	1.467E-10	4.976E-11
22	8.726E-11	9.533E-11	2.600E-11
23	3.714E-11	6.088E-11	1.697E-11
24	3.256E-11	4.517E-11	7.434E-12
25	2.452E-11	1.721E-11	1.573E-11
26	1.249E-11	2.582E-11	2.045E-11
27	2.980E-11	3.883E-11	8.804E-12
28	2.236E-11	1.661E-11	1.043E-11
29	9.295E-12	1.919E-11	1.995E-11
30	7.902E-12	1.026E-11	1.727E-11
31	1.006E-11	2.173E-11	6.501E-12
32	1.489E-11	1.825E-11	2.756E-12
33	9.601E-12	1.958E-11	8.929E-12
34	1.399E-11	2.278E-11	5.901E-12
35	1.371E-11	2.219E-11	1.621E-11
36	1.525E-11	9.964E-13	3.581E-12
37	6.848E-12	1.088E-11	3.337E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.675E-10	5.130E-10	4.744E-10
2	5.814E-10	5.099E-10	5.454E-10
3	4.819E-10	5.074E-10	4.202E-10
4	3.564E-10	5.456E-10	4.427E-10
5	3.515E-10	5.363E-10	3.745E-10
6	3.560E-10	5.027E-10	5.544E-10
7	4.170E-10	5.816E-10	4.231E-10
8	3.648E-10	4.659E-10	3.664E-10
9	2.957E-10	4.853E-10	4.011E-10
10	2.985E-10	3.976E-10	3.950E-10
11	2.417E-10	3.819E-10	4.217E-10
12	3.397E-10	3.861E-10	4.268E-10
13	2.206E-10	3.967E-10	2.441E-10
14	1.873E-10	3.419E-10	2.411E-10
15	2.740E-10	2.727E-10	2.271E-10
16	1.540E-10	2.488E-10	2.384E-10
17	8.779E-11	1.358E-10	1.344E-10
18	9.193E-11	2.501E-10	2.029E-10
19	9.278E-11	1.699E-10	2.220E-10
20	5.274E-11	2.200E-10	1.088E-10
21	3.857E-11	1.251E-10	1.207E-10
22	2.139E-11	5.507E-11	4.995E-11
23	8.336E-12	2.408E-11	2.518E-11
24	1.046E-11	2.310E-11	1.279E-11
25	6.330E-12	1.077E-11	1.390E-11
26	1.301E-11	1.488E-11	1.208E-11
27	1.740E-11	1.306E-11	1.286E-11
28	1.389E-11	1.484E-11	5.445E-13
29	1.133E-11	1.902E-11	8.779E-12
30	1.038E-11	1.480E-11	3.655E-12
31	5.290E-12	4.856E-12	9.724E-12
32	4.196E-12	7.464E-12	6.536E-12
33	1.684E-11	6.518E-12	5.422E-12
34	1.095E-11	8.598E-12	1.235E-11
35	0.	7.962E-12	2.599E-12
36	6.058E-12	3.765E-12	0.
37	3.157E-12	4.196E-12	9.502E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	3.145E-10	6.178E-10	1.361F-10
2	3.087E-10	5.541E-10	2.181E-10
3	3.008E-10	5.537E-10	1.833E-10
4	2.245E-10	3.413E-10	1.940E-10
5	2.713F-10	5.203E-10	1.757E-10
6	1.822E-10	4.274E-10	1.378E-10
7	2.093E-10	3.529E-10	1.356E-10
8	1.948F-10	3.757F-10	1.054E-10
9	2.793F-10	3.862F-10	1.382E-10
10	1.966E-10	2.871E-10	1.172E-10
11	1.292E-10	4.215E-10	6.001E-11
12	1.658E-10	2.665E-10	6.728F-11
13	1.933F-10	2.984F-10	8.438E-11
14	1.799E-10	2.449E-10	6.863E-11
15	1.345E-10	3.113E-10	6.994E-11
16	1.115F-10	2.313E-10	5.430E-11
17	7.511E-11	2.200E-10	2.627E-11
18	5.839E-11	1.779E-10	5.620E-11
19	7.210F-11	1.040E-10	3.749E-11
20	5.100F-11	9.926E-11	3.117E-13
21	3.197E-11	1.211E-10	4.517E-12
22	1.611F-11	3.777E-11	7.373E-12
23	4.037E-12	1.259E-11	4.263E-12
24	7.390E-12	5.928E-12	1.109E-13
25	3.129E-12	7.795E-12	0.
26	8.607E-12	2.220E-11	1.088E-12
27	2.706E-12	6.998E-12	1.020E-12
28	3.275E-12	2.933E-12	0.
29	7.509E-13	1.080E-11	0.
30	1.019E-11	5.662E-12	0.
31	5.021F-12	1.550E-12	0.
32	3.072E-13	2.470E-13	2.807E-12
33	4.551E-12	2.722E-12	0.
34	9.870E-12	5.824E-12	0.
35	9.354E-12	5.836E-12	0.
36	2.636E-12	3.102E-13	0.
37	1.099E-12	4.350F-12	2.472E-13

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RIBS

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	4.099E-10	5.204E-10	3.488E-10
2	3.457E-10	6.465E-10	3.449E-10
3	3.554E-10	3.926E-10	3.848E-10
4	4.214E-10	5.026E-10	4.119E-10
5	3.189E-10	5.211E-10	3.005E-10
6	4.090E-10	4.747E-10	2.465E-10
7	2.418E-10	5.060E-10	3.588E-10
8	3.445E-10	5.311E-10	3.207E-10
9	2.885E-10	4.020E-10	2.698E-10
10	2.741E-10	4.586E-10	2.567E-10
11	3.350E-10	4.731E-10	1.528E-10
12	1.782E-10	4.066E-10	1.965E-10
13	2.682E-10	3.241E-10	2.839E-10
14	2.760E-10	2.780E-10	2.252E-10
15	1.970E-10	2.668E-10	1.910E-10
16	1.838E-10	2.873E-10	1.223E-10
17	1.167E-10	2.290E-10	1.298E-10
18	2.118E-10	2.567E-10	1.164E-10
19	1.140E-10	2.124E-10	6.349E-11
20	9.989E-11	2.165E-10	5.574E-11
21	4.444E-11	6.935E-11	4.505E-11
22	1.787E-11	6.757E-11	2.289E-11
23	1.614E-11	4.185E-11	2.203E-11
24	1.856E-11	3.406E-11	9.233E-12
25	5.267E-12	1.230E-11	1.054E-11
26	3.590E-12	2.981E-11	3.122E-12
27	6.838E-12	1.203E-11	2.013E-11
28	9.159E-12	1.299E-11	1.970E-11
29	2.883E-12	1.513E-11	1.144E-11
30	8.085E-12	9.625E-12	1.161E-11
31	7.637E-12	1.806E-11	1.612E-11
32	2.681E-12	1.875E-11	7.347E-12
33	5.009E-12	3.118E-11	1.307E-11
34	1.845E-11	3.560E-12	1.066E-11
35	4.316E-12	2.538E-11	3.825E-12
36	2.969E-12	9.018E-12	5.358E-12
37	4.846E-12	1.181E-11	5.293E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	5.354E-10	5.829E-10	4.985E-10
2	4.158E-10	5.147E-10	5.501E-10
3	4.703E-10	5.706E-10	5.118E-10
4	5.338E-10	5.625E-10	4.739E-10
5	3.644E-10	3.826E-10	4.363E-10
6	4.770E-10	4.469E-10	4.267E-10
7	4.733E-10	5.655E-10	3.635E-10
8	5.264E-10	4.849E-10	4.394E-10
9	3.750E-10	5.145E-10	4.337E-10
10	4.042E-10	4.907E-10	5.053E-10
11	3.364E-10	3.976E-10	2.906E-10
12	3.695E-10	3.905E-10	2.904E-10
13	2.860E-10	3.202E-10	2.301E-10
14	2.550E-10	3.388E-10	2.249E-10
15	2.677E-10	2.934E-10	3.454E-10
16	1.402E-10	2.769E-10	2.185E-10
17	2.352E-10	1.929E-10	2.220E-10
18	1.535E-10	2.466E-10	1.453E-10
19	1.604E-10	2.651E-10	1.610E-10
20	1.007E-10	1.650E-10	1.917E-10
21	1.196E-10	1.057E-10	1.409E-10
22	4.588E-11	6.764E-11	8.085E-11
23	2.821E-11	3.034E-11	4.687E-11
24	2.473E-11	2.191E-11	4.114E-11
25	3.509E-11	3.375E-11	2.880E-11
26	1.081E-11	1.581E-11	3.070E-11
27	1.122E-11	7.537E-12	2.007E-11
28	2.229E-11	1.759E-11	9.516E-12
29	1.172E-11	1.035E-11	1.962E-11
30	2.107E-11	5.936E-12	2.968E-11
31	1.754E-11	2.692E-11	3.946E-11
32	1.894E-11	1.170E-11	3.654E-11
33	1.748E-11	2.155E-11	2.453E-11
34	3.628E-11	1.101E-11	3.562E-11
35	2.363E-11	2.230E-11	3.788E-11
36	3.384E-12	2.177E-11	4.858E-11
37	7.495E-12	7.404E-12	1.276E-11

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.813E-10	4.977E-10	5.754E-10
2	3.918E-10	5.315E-10	5.582E-10
3	3.752E-10	4.176E-10	5.426E-10
4	2.578E-10	4.917E-10	4.430E-10
5	3.353E-10	5.493E-10	4.498E-10
6	3.031E-10	4.007E-10	3.577E-10
7	2.943E-10	4.000E-10	4.283E-10
8	3.214E-10	5.138E-10	3.829E-10
9	2.174E-10	3.822E-10	3.078E-10
10	2.177E-10	4.106E-10	3.586E-10
11	1.426E-10	3.712E-10	2.848E-10
12	2.875E-10	3.441E-10	3.211E-10
13	2.065E-10	2.688E-10	3.400E-10
14	1.560E-10	2.688E-10	3.198E-10
15	1.050E-10	2.091E-10	3.656E-10
16	1.624E-10	2.208E-10	3.204E-10
17	1.371E-10	1.919E-10	1.708E-10
18	8.788E-11	1.831E-10	1.692E-10
19	1.274E-10	7.390E-11	2.234E-10
20	2.824E-11	1.285E-10	1.610E-10
21	1.194E-11	8.288E-11	1.240E-10
22	2.136E-11	5.688E-11	6.233E-11
23	1.378E-11	4.723E-11	2.624E-11
24	2.871E-12	3.029E-11	1.245E-11
25	2.886E-12	1.455E-11	2.700E-11
26	1.212E-12	1.468E-11	1.089E-11
27	1.808E-11	2.106E-11	1.306E-11
28	1.541E-11	3.434E-12	8.979E-12
29	6.977E-12	3.251E-11	1.528E-11
30	2.277E-12	2.616E-11	2.610E-11
31	5.540E-12	2.991E-11	1.936E-11
32	7.677E-12	1.484E-11	2.659E-11
33	9.063E-12	4.273E-11	1.964E-11
34	8.362E-12	2.339E-11	6.007E-11
35	2.185E-12	2.535E-11	2.135E-11
36	5.840E-12	1.387E-11	9.234E-12
37	2.019E-12	9.606E-12	9.001E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	3.907E-10	4.566E-10	2.139E-10
2	3.895E-10	5.231E-10	2.786E-10
3	3.014E-10	4.827E-10	2.605E-10
4	3.015E-10	4.127E-10	3.003E-10
5	2.636E-10	4.351E-10	2.424E-10
6	3.169E-10	3.824E-10	3.022E-10
7	3.411E-10	3.899E-10	2.982E-10
8	3.139E-10	3.502E-10	1.728E-10
9	2.964E-10	3.639E-10	2.226E-10
10	2.366E-10	3.154E-10	1.767E-10
11	2.868E-10	3.632E-10	2.106E-10
12	1.740E-10	3.289E-10	2.124E-10
13	1.362E-10	2.487E-10	1.559E-10
14	1.651E-10	3.423E-10	1.838E-10
15	1.379E-10	2.491E-10	1.280E-10
16	8.767E-11	2.211E-10	1.725E-10
17	1.268E-10	1.293E-10	1.141E-10
18	1.163E-10	2.001E-10	9.662E-11
19	7.339E-11	1.502E-10	8.945E-11
20	8.610E-11	9.469E-11	4.338E-11
21	2.409E-11	7.786E-11	2.948E-11
22	3.157E-11	7.204E-11	2.955E-11
23	2.102E-11	3.197E-11	6.403E-12
24	1.054E-11	2.689E-11	9.141E-12
25	1.890E-11	7.126E-12	6.119E-12
26	1.995E-12	1.722E-11	4.002E-12
27	6.516E-12	1.431E-11	4.731E-12
28	2.507E-12	6.609E-12	4.070E-12
29	1.057E-11	1.359E-11	1.066E-11
30	1.150E-11	1.530E-11	1.112E-15
31	1.366E-11	3.216E-12	0.
32	2.080E-11	1.341E-11	6.928E-12
33	8.453E-12	4.542E-12	3.822E-14
34	6.432E-12	1.809E-11	2.122E-13
35	2.158E-11	5.399E-12	2.622E-12
36	1.293E-11	5.904E-12	2.637E-12
37	5.271E-12	5.060E-12	1.288E-12

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SCAPULA

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	4.560E-10	6.056E-10	3.012E-10
2	3.593E-10	5.402E-10	2.266E-10
3	4.032E-10	4.490E-10	2.588E-10
4	3.496E-10	4.885E-10	2.535E-10
5	2.311E-10	4.184E-10	2.098E-10
6	4.014E-10	4.288E-10	1.732E-10
7	3.086E-10	4.360E-10	1.497E-10
8	3.429E-10	4.155E-10	1.943E-10
9	2.723E-10	3.550E-10	1.936E-10
10	2.874E-10	3.522E-10	1.329E-10
11	3.316E-10	3.757E-10	8.701E-11
12	2.854E-10	3.484E-10	1.416E-10
13	1.818E-10	3.154E-10	6.948E-11
14	1.949E-10	2.332E-10	8.600E-11
15	2.354E-10	2.397E-10	8.009E-11
16	2.068E-10	2.675E-10	1.318E-11
17	1.051E-10	1.936E-10	5.225E-11
18	1.447E-10	1.388E-10	4.516E-11
19	1.014E-10	2.032E-10	4.820E-11
20	7.254E-11	1.616E-10	4.208E-11
21	3.629E-11	6.447E-11	1.896E-11
22	2.941E-11	2.816E-11	3.623E-12
23	1.212E-11	2.029E-11	5.877E-12
24	1.605E-11	2.187E-11	6.649E-13
25	1.381E-12	1.117E-11	4.392E-13
26	6.199E-12	9.469E-12	1.997E-12
27	1.021E-11	9.294E-12	0.
28	4.001E-12	1.146E-11	8.440E-12
29	1.367E-11	3.037E-11	3.798E-12
30	1.116E-11	8.071E-12	5.475E-12
31	2.512E-12	1.693E-11	1.119E-11
32	5.209E-12	1.678E-11	8.068E-12
33	3.159E-12	1.567E-11	6.046E-12
34	5.204E-12	1.393E-11	5.108E-12
35	4.912E-12	3.751E-11	0.
36	0.	1.822E-13	0.
37	5.188E-13	9.497E-12	1.622E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	7.330E-10	7.287E-10	4.242E-10
2	6.370E-10	6.301E-10	4.142E-10
3	7.010E-10	5.851E-10	3.064E-10
4	5.931E-10	5.449E-10	4.281E-10
5	7.131E-10	5.603E-10	4.541E-10
6	6.380E-10	5.103E-10	2.753E-10
7	4.894E-10	6.043E-10	4.168E-10
8	5.486E-10	5.969E-10	2.831E-10
9	4.758E-10	5.278E-10	2.658E-10
10	4.889E-10	3.689E-10	3.079E-10
11	5.720E-10	5.651E-10	2.756E-10
12	5.076E-10	3.835E-10	1.283E-10
13	5.002E-10	2.940E-10	2.081E-10
14	2.435E-10	3.840E-10	2.171E-10
15	4.889E-10	3.575E-10	2.017E-10
16	5.054E-10	3.093E-10	9.745E-11
17	2.640E-10	3.264E-10	1.153E-10
18	3.012E-10	2.969E-10	1.003E-10
19	2.753E-10	3.106E-10	7.774E-11
20	1.592E-10	2.270E-10	7.264E-11
21	1.498E-10	1.208E-10	3.414E-11
22	1.144E-10	6.909E-11	1.784E-11
23	6.459E-11	5.660E-11	1.439E-11
24	3.188E-11	2.585E-11	1.587E-11
25	1.354E-11	1.507E-11	8.543E-12
26	1.692E-11	1.504E-11	3.311E-12
27	2.276E-11	1.507E-11	5.894E-12
28	9.421E-12	5.256E-12	4.600E-12
29	5.924E-12	1.474E-11	8.017E-12
30	1.416E-11	3.696E-12	3.941E-12
31	1.355E-11	2.291E-11	3.715E-12
32	3.313E-11	8.211E-12	7.381E-12
33	2.000E-11	7.639E-12	3.067E-12
34	1.992E-11	2.290E-11	8.962E-12
35	2.461E-11	2.390E-11	8.825E-12
36	1.639E-11	3.709E-11	3.426E-12
37	8.620E-12	1.022E-11	1.339E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.252E-10	7.138E-10	5.078E-10
2	3.603E-10	5.731E-10	5.609E-10
3	2.637E-10	6.414E-10	4.575E-10
4	2.752E-10	6.467E-10	3.021E-10
5	2.750E-10	5.793E-10	4.211E-10
6	2.252E-10	6.251E-10	4.220E-10
7	2.207E-10	5.480E-10	3.259E-10
8	1.947E-10	6.987E-10	3.034E-10
9	2.104E-10	6.377E-10	3.722E-10
10	2.103E-10	4.800E-10	3.708E-10
11	2.009E-10	5.249E-10	3.167E-10
12	1.716E-10	5.905E-10	4.160E-10
13	1.886E-10	3.825E-10	3.650E-10
14	9.818E-11	4.235E-10	2.861E-10
15	7.866E-11	5.015E-10	2.580E-10
16	1.122E-10	4.449E-10	2.018E-10
17	8.504E-11	2.737E-10	1.941E-10
18	5.586E-11	3.049E-10	1.662E-10
19	4.214E-11	3.461E-10	1.652E-10
20	1.700E-11	2.975E-10	1.650E-10
21	2.028E-11	2.685E-10	7.749E-11
22	1.529E-11	1.406E-10	4.571E-11
23	2.704E-12	8.113E-11	2.905E-11
24	4.768E-12	4.873E-11	9.941E-12
25	3.799E-12	4.400E-11	7.807E-12
26	5.989E-12	2.212E-11	1.475E-11
27	9.071E-12	4.192E-11	6.694E-12
28	9.200E-12	2.528E-11	6.472E-12
29	4.972E-12	1.710E-11	1.966E-11
30	0.	2.796E-11	1.075E-11
31	0.	1.133E-11	2.244E-11
32	7.021E-12	3.509E-11	1.716E-11
33	1.802E-12	1.714E-11	4.440E-12
34	7.854E-12	3.359E-11	3.091E-12
35	4.441E-12	5.607E-11	2.227E-11
36	0.	2.769E-11	4.886E-11
37	3.827E-12	1.874E-11	6.284E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	2.067E-10	6.463E-10	2.947E-10
2	2.705E-10	5.770E-10	2.198E-10
3	2.027E-10	6.982E-10	2.378E-10
4	1.774E-10	6.453E-10	3.319E-10
5	1.654E-10	5.485E-10	3.274E-10
6	1.957E-10	5.295E-10	2.566E-10
7	2.262E-10	4.302E-10	2.315E-10
8	2.367E-10	5.693E-10	2.312E-10
9	1.458E-10	5.402E-10	2.233E-10
10	1.294E-10	4.928E-10	2.653E-10
11	1.801E-10	5.751E-10	2.570E-10
12	7.677E-11	4.941E-10	1.673E-10
13	1.300E-10	3.852E-10	1.528E-10
14	6.901E-11	3.504E-10	1.316E-10
15	5.588E-11	4.372E-10	5.705E-11
16	4.875E-11	3.693E-10	1.593E-10
17	6.625E-11	2.216E-10	1.026E-10
18	5.076E-11	2.758E-10	9.962E-11
19	3.145E-11	2.066E-10	6.074E-11
20	2.439E-11	1.942E-10	6.495E-11
21	8.537E-12	1.252E-10	2.766E-11
22	6.540E-12	7.259E-11	2.108E-11
23	1.622E-13	3.880E-11	5.481E-12
24	4.236E-13	3.565E-11	4.620E-12
25	0.	2.054E-11	1.715E-11
26	2.904E-12	2.554E-11	6.437E-12
27	3.927E-12	1.531E-11	2.839E-12
28	2.297E-12	4.723E-12	5.038E-12
29	2.063E-12	2.907E-11	1.585E-12
30	0.	1.252E-11	1.406E-12
31	5.403E-12	1.052E-11	1.197E-13
32	4.103E-12	9.622E-12	1.000E-11
33	2.673E-12	1.952E-11	2.937E-12
34	0.	1.296E-11	0.
35	0.	1.690E-11	5.198E-12
36	0.	1.376E-11	0.
37	2.557E-14	1.127E-11	1.803E-12

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ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	1.415E-10	4.843E-10	4.428E-10
2	1.277E-10	4.436E-10	2.287E-10
3	1.237E-10	4.316E-10	3.479E-10
4	1.055E-10	3.808E-10	2.579E-10
5	1.297E-10	4.093E-10	2.775E-10
6	1.521E-10	3.611E-10	2.567E-10
7	9.808E-11	3.362E-10	1.944E-10
8	1.187E-10	2.873E-10	2.134E-10
9	1.132E-10	3.296E-10	2.374E-10
10	1.237E-10	3.369E-10	2.304E-10
11	1.069E-10	2.472E-10	1.725E-10
12	8.178E-11	2.916E-10	2.195E-10
13	5.074E-11	2.351E-10	1.973E-10
14	3.635E-11	2.297E-10	1.185E-10
15	4.079E-11	1.696E-10	8.959E-11
16	4.634E-11	1.975E-10	1.148E-10
17	9.655E-12	1.437E-10	7.685E-11
18	3.981E-12	9.985E-11	4.455E-11
19	3.013E-12	1.079E-10	6.027E-11
20	1.234E-11	4.292E-11	1.594E-11
21	1.792E-11	8.229E-12	1.050E-11
22	7.944E-12	1.702E-11	1.622E-11
23	5.388E-13	9.499E-12	3.114E-12
24	3.006E-12	2.328E-11	1.395E-12
25	4.329E-12	9.392E-12	1.143E-11
26	3.563E-12	1.489E-11	4.090E-12
27	6.845E-12	1.587E-11	4.200E-12
28	3.796E-12	1.129E-11	1.368E-11
29	0.	1.365E-11	5.582E-12
30	1.451E-11	0.	4.820E-12
31	0.	1.160E-11	1.433E-12
32	3.426E-12	7.350E-12	7.362E-12
33	1.122E-11	5.315E-12	5.179E-12
34	5.005E-12	8.518E-12	0.
35	0.	1.255E-11	0.
36	0.	0.	7.890E-12
37	2.053E-12	3.292E-12	2.991E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	4.045E-10	5.031E-10	4.842E-10
2	4.168E-10	5.248E-10	5.655E-10
3	4.291E-10	4.697E-10	4.996E-10
4	4.533E-10	4.849E-10	5.609E-10
5	3.204E-10	5.793E-10	4.202E-10
6	3.539E-10	3.551E-10	3.801E-10
7	4.089E-10	4.871E-10	4.615E-10
8	3.478E-10	4.643E-10	4.016E-10
9	3.228E-10	4.112E-10	4.081E-10
10	2.340E-10	3.374E-10	4.236E-10
11	2.516E-10	3.181E-10	4.781E-10
12	3.197E-10	3.386E-10	3.533E-10
13	2.137E-10	3.504E-10	2.710E-10
14	1.700E-10	3.062E-10	2.235E-10
15	2.159E-10	1.924E-10	2.072E-10
16	9.097E-11	2.154E-10	2.254E-10
17	1.272E-10	2.161E-10	1.229E-10
18	5.985E-11	1.325E-10	1.469E-10
19	3.564E-11	1.276E-10	1.399E-10
20	6.592E-11	1.068E-10	1.031E-10
21	3.481E-11	4.128E-11	4.731E-11
22	2.297E-11	1.926E-11	2.341E-11
23	2.202E-11	2.144E-11	1.519E-11
24	1.319E-11	5.456E-12	2.574E-11
25	1.134E-11	2.618E-11	2.114E-11
26	2.562E-11	1.583E-11	8.817E-12
27	5.543E-12	1.340E-11	2.159E-11
28	1.806E-11	3.175E-11	1.614E-11
29	1.640E-11	3.882E-11	2.036E-11
30	1.943E-11	2.949E-11	1.899E-11
31	1.105E-11	1.679E-11	2.055E-11
32	6.534E-12	2.550E-11	2.927E-11
33	1.787E-11	1.062E-11	2.263E-11
34	1.468E-11	1.473E-11	7.585E-12
35	1.166E-11	9.627E-12	1.302E-11
36	6.383E-12	4.013E-11	8.789E-12
37	6.192E-12	5.535E-12	1.261E-11

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.520E-10	5.349E-10	5.418E-10
2	3.781E-10	5.235E-10	5.266E-10
3	2.772E-10	4.804E-10	4.669E-10
4	3.576E-10	4.809E-10	4.409E-10
5	3.643E-10	5.560E-10	4.330E-10
6	2.872E-10	4.095E-10	3.911E-10
7	1.929E-10	4.976E-10	3.663E-10
8	2.688E-10	4.409E-10	4.292E-10
9	2.315E-10	4.037E-10	3.772E-10
10	2.205E-10	3.490E-10	2.980E-10
11	2.493E-10	3.434E-10	2.883E-10
12	2.151E-10	3.548E-10	3.490E-10
13	1.108E-10	2.378E-10	2.672E-10
14	1.405E-10	2.177E-10	2.552E-10
15	9.301E-11	2.108E-10	2.239E-10
16	1.177E-10	1.776E-10	1.365E-10
17	8.770E-11	1.345E-10	1.450E-10
18	1.201E-10	2.068E-10	1.436E-10
19	5.208E-11	1.954E-10	1.972E-10
20	3.879E-11	1.543E-10	1.016E-10
21	1.759E-11	6.103E-11	3.114E-11
22	7.953E-12	2.389E-11	2.221E-11
23	1.118E-11	2.544E-11	2.465E-11
24	7.166E-12	2.553E-11	1.954E-11
25	7.692E-12	1.604E-11	8.308E-12
26	1.581E-11	5.204E-11	9.122E-12
27	8.360E-12	1.545E-11	1.255E-11
28	8.017E-12	3.019E-11	4.712E-12
29	7.801E-12	1.675E-11	1.391E-11
30	2.025E-12	2.805E-11	7.247E-12
31	1.123E-11	2.294E-11	2.116E-11
32	1.757E-11	2.080E-11	9.170E-12
33	2.579E-12	1.620E-11	1.659E-11
34	9.331E-12	2.742E-11	1.335E-11
35	5.639E-12	1.148E-11	2.574E-12
36	8.014E-12	8.852E-12	6.061E-12
37	2.236E-12	5.831E-12	9.846E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	4.227E-10	4.919E-10	2.835E-10
2	3.767E-10	5.282E-10	2.999E-10
3	3.700E-10	4.621E-10	2.676E-10
4	3.226E-10	4.238E-10	2.823E-10
5	2.991E-10	3.561E-10	2.410E-10
6	2.479E-10	5.271E-10	2.575E-10
7	2.508E-10	4.145E-10	2.013E-10
8	2.500E-10	3.347E-10	1.835E-10
9	2.263E-10	3.336E-10	1.673E-10
10	2.985E-10	3.466E-10	2.038E-10
11	2.907E-10	2.990E-10	1.335E-10
12	2.523E-10	2.829E-10	1.446E-10
13	2.131E-10	2.605E-10	1.403E-10
14	1.734E-10	2.017E-10	9.230E-11
15	9.682E-11	1.759E-10	8.039E-11
16	1.017E-10	1.375E-10	6.813E-11
17	1.435E-10	1.389E-10	9.599E-11
18	1.920E-10	1.704E-10	4.336E-11
19	1.054E-10	1.488E-10	6.438E-11
20	3.574E-11	4.771E-11	1.878E-11
21	2.759E-11	3.629E-11	1.511E-11
22	8.665E-12	1.471E-11	6.124E-12
23	6.115E-12	1.331E-11	9.086E-12
24	1.009E-11	1.698E-11	5.609E-12
25	2.358E-12	1.447E-11	5.183E-13
26	3.797E-12	1.788E-11	4.164E-12
27	2.084E-11	2.493E-11	5.865E-12
28	9.426E-12	1.615E-11	2.069E-12
29	1.634E-11	2.384E-11	2.402E-12
30	6.757E-12	3.391E-11	7.239E-12
31	1.414E-11	2.736E-11	1.466E-12
32	6.926E-12	1.064E-11	6.685E-12
33	9.758E-12	2.593E-11	5.178E-12
34	2.256E-12	2.131E-11	1.259E-11
35	1.014E-11	5.995E-12	8.519E-12
36	2.758E-12	1.836E-11	2.553E-12
37	5.719E-12	8.405E-12	8.610E-13

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ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	5.351E-10	6.789E-10	3.971E-10
2	5.080E-10	5.197E-10	2.770E-10
3	4.628E-10	4.760E-10	2.947E-10
4	4.735E-10	6.322E-10	2.087E-10
5	3.773E-10	7.008E-10	3.559E-10
6	3.525E-10	5.999E-10	2.430E-10
7	3.898E-10	5.135E-10	2.518E-10
8	3.487E-10	5.670E-10	2.143E-10
9	3.597E-10	4.865E-10	1.641E-10
10	3.581E-10	4.948E-10	1.941E-10
11	3.910E-10	6.118E-10	2.520E-10
12	2.040E-10	4.293E-10	1.506E-10
13	2.758E-10	4.058E-10	1.275E-10
14	3.141E-10	4.241E-10	1.099E-10
15	2.679E-10	3.829E-10	1.278E-10
16	2.751E-10	3.670E-10	9.568E-11
17	1.991E-10	3.419E-10	4.762E-11
18	1.037E-10	2.250E-10	5.827E-11
19	1.870E-10	2.850E-10	5.691E-11
20	1.074E-10	2.196E-10	2.841E-11
21	6.491E-11	1.508E-10	2.239E-11
22	5.174E-11	8.618E-11	1.455E-11
23	8.583E-12	3.325E-11	4.047E-12
24	5.865E-12	3.500E-11	1.042E-12
25	9.518E-12	1.397E-11	1.924E-12
26	1.337E-11	2.484E-11	9.534E-14
27	2.000E-12	1.026E-11	3.866E-12
28	3.522E-12	8.439E-12	5.142E-12
29	2.861E-12	1.047E-11	3.723E-12
30	2.788E-12	5.945E-12	6.689E-13
31	9.348E-12	1.865E-11	5.615E-12
32	1.425E-11	1.508E-11	2.754E-12
33	9.840E-12	7.314E-12	1.505E-13
34	4.181E-12	2.632E-11	7.145E-13
35	3.304E-12	1.766E-11	7.742E-12
36	1.865E-11	1.009E-11	4.476E-12
37	6.340E-12	9.743E-12	1.392E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	5.569E-10	7.619E-10	5.853E-10
2	5.328E-10	6.859E-10	6.423E-10
3	3.582E-10	5.365E-10	4.543E-10
4	4.777E-10	5.945E-10	4.187E-10
5	4.077E-10	6.883E-10	4.240E-10
6	4.409E-10	5.773E-10	4.509E-10
7	5.109E-10	5.707E-10	4.584E-10
8	4.249E-10	5.642E-10	4.215E-10
9	4.393E-10	5.055E-10	4.789E-10
10	4.234E-10	4.649E-10	4.872E-10
11	3.156E-10	5.252E-10	3.771E-10
12	2.365E-10	4.541E-10	3.956E-10
13	3.585E-10	5.067E-10	3.827E-10
14	3.177E-10	5.105E-10	3.497E-10
15	4.052E-10	3.711E-10	2.478E-10
16	2.532E-10	2.941E-10	2.736E-10
17	1.975E-10	2.812E-10	2.726E-10
18	2.049E-10	2.588E-10	2.089E-10
19	1.762E-10	3.087E-10	1.178E-10
20	6.622E-11	2.882E-10	2.074E-10
21	7.059E-11	1.859E-10	7.273E-11
22	3.709E-11	1.237E-10	6.434E-11
23	1.232E-11	5.918E-11	1.967E-11
24	1.499E-11	3.215E-11	1.768E-11
25	1.066E-11	3.773E-11	6.926E-12
26	1.588E-11	1.178E-11	3.091E-12
27	4.430E-12	9.581E-12	1.636E-11
28	1.473E-12	1.445E-11	1.700E-11
29	6.756E-12	9.960E-12	1.202E-11
30	2.828E-12	1.524E-11	1.369E-11
31	6.635E-12	2.635E-11	7.508E-12
32	1.125E-11	2.020E-11	7.262E-12
33	4.087E-12	2.068E-11	1.676E-11
34	2.765E-12	1.058E-11	2.265E-11
35	3.322E-12	3.332E-11	1.225E-11
36	3.968E-11	1.688E-11	8.149E-12
37	4.360E-12	1.221E-11	4.539E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	2.056E-10	5.512E-10	6.132E-10
2	2.568E-10	4.837E-10	6.200E-10
3	2.356E-10	4.559E-10	6.407E-10
4	2.684E-10	5.136E-10	6.215E-10
5	2.016E-10	4.253E-10	5.490E-10
6	2.063E-10	4.504E-10	5.631E-10
7	1.540E-10	5.267E-10	4.821E-10
8	1.233E-10	5.763E-10	4.721E-10
9	1.351E-10	5.800E-10	5.062E-10
10	1.527E-10	4.273E-10	5.632E-10
11	1.232E-10	3.801E-10	4.847E-10
12	7.931E-11	3.477E-10	3.941E-10
13	5.847E-11	3.910E-10	4.342E-10
14	4.675E-11	3.467E-10	3.637E-10
15	6.266E-11	3.090E-10	2.990E-10
16	2.844E-11	3.148E-10	3.204E-10
17	1.789E-11	2.038E-10	2.273E-10
18	1.589E-11	3.371E-10	3.493E-10
19	3.310E-11	2.130E-10	2.371E-10
20	3.775E-12	2.552E-10	2.076E-10
21	4.055E-12	8.635E-11	1.094E-10
22	1.208E-14	3.168E-11	8.132E-11
23	1.210E-12	2.654E-11	5.438E-11
24	1.707E-12	2.074E-11	3.547E-11
25	0.	7.194E-12	2.369E-11
26	3.898E-13	4.903E-12	2.229E-11
27	6.078E-13	2.102E-11	9.309E-12
28	0.	3.175E-12	1.204E-11
29	7.196E-13	1.477E-11	6.677E-12
30	0.	5.334E-12	5.269E-12
31	0.	1.804E-12	1.874E-11
32	4.890E-12	8.081E-12	1.185E-11
33	0.	2.173E-11	1.409E-11
34	2.802E-12	9.350E-12	7.631E-12
35	0.	1.199E-11	4.888E-12
36	0.	5.908E-12	5.925E-12
37	1.235E-12	8.204E-12	1.025E-11

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	3.183E-10	5.184E-10	3.662E-10
2	2.842E-10	5.234E-10	3.001E-10
3	2.121E-10	4.971E-10	2.503E-10
4	2.721E-10	3.892E-10	2.288E-10
5	2.237E-10	4.169E-10	2.647E-10
6	2.380E-10	4.871E-10	2.848E-10
7	2.446E-10	4.327E-10	2.625E-10
8	1.926E-10	3.469E-10	2.088E-10
9	1.283E-10	4.515E-10	2.924E-10
10	1.916E-10	3.743E-10	1.891E-10
11	1.147E-10	2.807E-10	2.245E-10
12	1.566E-10	2.910E-10	2.116E-10
13	1.437E-10	3.319E-10	2.092E-10
14	1.439E-10	2.820E-10	1.488E-10
15	1.274E-10	3.921E-10	1.174E-10
16	5.796E-11	1.553E-10	1.314E-10
17	2.016E-11	1.880E-10	8.329E-11
18	5.610E-11	1.897E-10	1.192E-10
19	3.235E-11	1.868E-10	1.030E-10
20	1.847E-11	1.003E-10	7.229E-11
21	2.276E-11	1.158E-10	4.281E-11
22	2.484E-12	4.730E-11	4.678E-12
23	3.872E-12	2.241E-11	9.919E-12
24	6.328E-12	1.364E-11	6.223E-12
25	4.950E-13	9.767E-12	2.761E-12
26	3.303E-12	1.345E-11	9.750E-13
27	1.030E-11	6.608E-12	3.074E-12
28	1.747E-14	2.132E-12	4.366E-12
29	1.317E-13	2.000E-12	1.175E-12
30	4.357E-12	3.162E-12	1.112E-13
31	0.	5.906E-12	2.783E-12
32	3.213E-12	9.579E-12	0.
33	3.309E-12	1.415E-11	2.919E-12
34	0.	4.208E-12	2.327E-12
35	0.	2.155E-11	5.822E-12
36	1.510E-11	7.443E-13	1.560E-13
37	1.100E-12	6.852E-12	3.683E-12

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ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	4.509E-10	6.915E-10	5.314E-10
2	5.064E-10	6.038E-10	6.323E-10
3	3.787E-10	6.591E-10	5.159E-10
4	4.909E-10	5.292E-10	5.628E-10
5	4.392E-10	6.583E-10	4.725E-10
6	4.874E-10	5.642E-10	4.691E-10
7	3.988E-10	5.344E-10	4.684E-10
8	4.239E-10	4.901E-10	3.646E-10
9	3.807E-10	5.710E-10	3.615E-10
10	3.632E-10	4.637E-10	3.543E-10
11	3.806E-10	5.042E-10	4.178E-10
12	3.667E-10	4.115E-10	4.011E-10
13	3.187E-10	4.417E-10	2.323E-10
14	3.177E-10	4.741E-10	2.930E-10
15	2.265E-10	4.493E-10	2.711E-10
16	3.045E-10	3.316E-10	3.052E-10
17	2.860E-10	2.481E-10	1.649E-10
18	1.886E-10	2.236E-10	1.836E-10
19	1.573E-10	2.480E-10	1.966E-10
20	1.683E-10	2.748E-10	1.947E-10
21	1.108E-10	1.825E-10	7.998E-11
22	7.479E-11	9.347E-11	4.285E-11
23	2.316E-11	6.557E-11	2.873E-11
24	2.196E-11	4.128E-11	2.829E-11
25	2.419E-11	1.871E-11	6.989E-12
26	6.555E-12	1.583E-11	6.163E-12
27	2.733E-12	2.350E-11	5.516E-12
28	1.118E-11	3.233E-11	2.767E-12
29	3.188E-12	2.568E-11	1.284E-11
30	1.281E-12	1.966E-11	6.636E-12
31	1.161E-11	1.933E-11	1.229E-11
32	1.867E-11	3.343E-11	9.141E-12
33	9.724E-12	2.716E-11	4.386E-12
34	1.005E-11	1.573E-11	2.408E-11
35	5.240E-12	2.245E-11	1.535E-11
36	2.428E-11	6.163E-11	3.180E-11
37	8.211E-12	1.793E-11	8.802E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	3.825E-10	5.689E-10	7.517E-10
2	3.926E-10	5.646E-10	6.762E-10
3	4.540E-10	4.986E-10	5.940E-10
4	4.255E-10	5.117E-10	6.574E-10
5	4.923E-10	5.254E-10	5.695E-10
6	3.591E-10	3.308E-10	6.380E-10
7	3.491E-10	4.924E-10	5.568E-10
8	3.687E-10	3.710E-10	4.652E-10
9	2.606E-10	4.030E-10	5.421E-10
10	2.170E-10	4.528E-10	4.978E-10
11	3.532E-10	3.448E-10	4.152E-10
12	2.481E-10	3.369E-10	4.002E-10
13	1.864E-10	3.899E-10	4.454E-10
14	1.938E-10	3.024E-10	5.275E-10
15	2.066E-10	2.952E-10	4.366E-10
16	1.398E-10	2.384E-10	3.805E-10
17	1.221E-10	2.217E-10	3.399E-10
18	9.890E-11	1.370E-10	2.736E-10
19	6.338E-11	1.337E-10	2.596E-10
20	1.002E-10	1.555E-10	2.637E-10
21	5.591E-11	8.032E-11	1.766E-10
22	2.077E-11	3.256E-11	8.145E-11
23	9.722E-12	2.352E-11	6.233E-11
24	2.017E-11	2.296E-11	5.156E-11
25	1.151E-11	1.953E-11	3.111E-11
26	1.351E-11	2.593E-12	3.753E-11
27	1.107E-11	1.837E-11	1.984E-11
28	1.177E-11	1.035E-11	3.733E-11
29	1.391E-11	1.385E-11	2.695E-11
30	3.690E-12	1.324E-11	3.029E-11
31	4.572E-12	1.435E-11	1.398E-11
32	5.447E-12	1.166E-11	2.140E-11
33	1.556E-11	1.451E-11	3.108E-11
34	2.196E-11	1.576E-11	4.152E-11
35	6.896E-12	8.005E-12	2.443E-11
36	6.084E-11	3.912E-12	7.064E-11
37	4.973E-12	7.384E-12	2.458E-11

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	2.941E-10	2.974E-10	5.076E-10
2	4.366E-10	3.541E-10	5.021E-10
3	3.434E-10	2.606E-10	5.131E-10
4	3.223E-10	2.082E-10	4.836E-10
5	3.433E-10	2.301E-10	4.168E-10
6	3.895E-10	2.655E-10	4.007E-10
7	3.038E-10	3.117E-10	3.989E-10
8	3.166E-10	1.883E-10	3.579E-10
9	2.333E-10	1.661E-10	3.233E-10
10	2.273E-10	1.771E-10	3.661E-10
11	3.165E-10	1.856E-10	4.991E-10
12	2.068E-10	3.199E-10	3.241E-10
13	2.717E-10	1.120E-10	4.420E-10
14	2.241E-10	9.793E-11	4.357E-10
15	1.780E-10	9.816E-11	3.311E-10
16	1.316E-10	3.337E-11	3.301E-10
17	1.588E-10	5.994E-11	2.463E-10
18	1.622E-10	4.078E-11	2.103E-10
19	7.058E-11	6.237E-11	1.571E-10
20	6.186E-11	6.096E-11	1.255E-10
21	6.369E-11	1.528E-11	1.038E-10
22	1.112E-11	8.636E-12	5.162E-11
23	1.267E-11	1.201E-11	2.056E-11
24	7.587E-12	5.801E-12	3.195E-11
25	1.087E-11	1.165E-11	1.508E-11
26	1.074E-11	2.559E-12	1.384E-11
27	7.450E-12	7.388E-12	1.415E-11
28	2.831E-12	6.714E-12	6.540E-12
29	6.262E-12	0.	1.433E-11
30	5.794E-12	4.460E-12	3.901E-12
31	4.168E-12	0.	1.199E-11
32	9.965E-12	5.503E-12	2.243E-11
33	5.760E-12	1.384E-11	1.569E-11
34	0.	3.520E-12	1.060E-11
35	9.753E-12	2.976E-12	7.930E-12
36	3.265E-12	1.145E-11	3.363E-12
37	1.994E-12	4.118E-12	8.357E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	4.571E-10	2.322E-10	3.117E-10
2	4.145E-10	2.000E-10	2.727E-10
3	5.071E-10	2.352E-10	2.296E-10
4	4.292E-10	1.902E-10	2.291E-10
5	3.878E-10	1.845E-10	1.618E-10
6	3.847E-10	2.394E-10	2.774E-10
7	4.571E-10	1.604E-10	2.362E-10
8	4.389E-10	1.549E-10	2.266E-10
9	3.521E-10	1.186E-10	2.131E-10
10	3.748E-10	1.005E-10	2.217E-10
11	3.338E-10	2.158E-10	1.984E-10
12	2.680E-10	1.851E-10	1.773E-10
13	3.367E-10	1.302E-10	1.445E-10
14	2.263E-10	7.914E-11	1.010E-10
15	3.583E-10	7.927E-11	1.149E-10
16	2.522E-10	4.815E-11	8.813E-11
17	1.893E-10	1.492E-11	9.407E-11
18	1.527E-10	3.398E-11	1.360E-10
19	1.020E-10	6.088E-12	4.733E-11
20	1.278E-10	1.707E-11	5.157E-11
21	8.430E-11	1.052E-11	2.925E-11
22	4.968E-11	3.178E-12	4.125E-13
23	1.571E-11	8.201E-14	7.532E-12
24	2.033E-11	4.081E-12	2.953E-12
25	1.468E-11	0.	5.966E-12
26	4.931E-12	7.047E-13	9.057E-13
27	5.263E-12	6.541E-12	3.046E-12
28	8.695E-12	5.643E-14	2.731E-12
29	3.808E-12	3.312E-12	5.094E-12
30	1.717E-11	0.	0.
31	2.045E-12	1.101E-11	2.837E-12
32	4.298E-12	1.029E-11	3.482E-12
33	1.477E-11	5.922E-12	0.
34	1.467E-11	2.319E-12	5.261E-12
35	1.641E-11	8.894E-12	5.338E-12
36	5.198E-11	3.168E-12	1.501E-13
37	6.959E-12	8.533E-13	1.768E-12

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REFERENCE MAN

ENERGY GROUP	BIN 1 RESPONSE	BIN 2 RESPONSE	BIN 3 RESPONSE
1	3.443E-10	5.447E-10	3.491E-10
2	2.718E-10	4.760E-10	3.073E-10
3	2.642E-10	4.188E-10	3.163E-10
4	2.840E-10	3.982E-10	2.680E-10
5	2.755E-10	3.934E-10	2.920E-10
6	2.833E-10	3.951E-10	2.809E-10
7	2.442E-10	3.842E-10	2.511E-10
8	2.095E-10	3.742E-10	2.380E-10
9	1.738E-10	3.517E-10	2.405E-10
10	2.193E-10	3.551E-10	2.328E-10
11	2.090E-10	3.278E-10	1.856E-10
12	1.600E-10	3.143E-10	1.720E-10
13	1.411E-10	2.610E-10	1.932E-10
14	1.296E-10	2.618E-10	1.390E-10
15	1.314E-10	2.193E-10	1.113E-10
16	1.101E-10	1.677E-10	9.860E-11
17	8.805E-11	1.467E-10	1.036E-10
18	8.191E-11	1.195E-10	8.791E-11
19	7.468E-11	1.355E-10	7.328E-11
20	4.181E-11	1.100E-10	4.619E-11
21	3.551E-11	6.412E-11	2.477E-11
22	1.816E-11	3.230E-11	1.146E-11
23	1.226E-11	1.884E-11	9.945E-12
24	9.506E-12	1.919E-11	1.354E-11
25	8.695E-12	1.454E-11	1.003E-11
26	6.006E-12	1.579E-11	4.941E-12
27	7.867E-12	1.937E-11	8.117E-12
28	5.442E-12	1.061E-11	1.108E-11
29	1.470E-11	1.428E-11	1.035E-11
30	6.643E-12	1.187E-11	8.148E-12
31	4.611E-12	1.094E-11	6.046E-12
32	4.078E-12	1.556E-11	6.521E-12
33	1.093E-11	2.005E-11	8.654E-12
34	8.115E-12	1.249E-11	5.341E-12
35	3.505E-12	9.141E-12	6.919E-12
36	4.322E-12	1.327E-11	9.015E-12
37	3.586E-12	6.066E-12	3.752E-12

ENERGY GROUP	BIN 4 RESPONSE	BIN 5 RESPONSE	BIN 6 RESPONSE
1	4.877E-10	5.836E-10	4.262E-10
2	4.956E-10	5.617E-10	4.405E-10
3	4.371E-10	4.519E-10	4.103E-10
4	5.378E-10	5.219E-10	4.282E-10
5	4.932E-10	4.472E-10	4.251E-10
6	4.866E-10	4.787E-10	4.740E-10
7	4.670E-10	4.611E-10	3.627E-10
8	4.343E-10	4.465E-10	3.068E-10
9	3.943E-10	4.146E-10	3.745E-10
10	3.666E-10	3.266E-10	3.667E-10
11	3.529E-10	3.595E-10	3.044E-10
12	3.300E-10	3.265E-10	2.745E-10
13	3.194E-10	3.049E-10	2.513E-10
14	2.664E-10	3.060E-10	2.238E-10
15	3.243E-10	2.588E-10	2.145E-10
16	2.158E-10	2.136E-10	1.518E-10
17	2.057E-10	2.077E-10	1.132E-10
18	1.500E-10	1.791E-10	1.432E-10
19	1.350E-10	1.881E-10	1.203E-10
20	1.188E-10	1.521E-10	1.380E-10
21	7.943E-11	7.433E-11	6.401E-11
22	4.665E-11	4.090E-11	3.001E-11
23	2.660E-11	3.230E-11	2.137E-11
24	2.087E-11	2.268E-11	1.889E-11
25	2.034E-11	2.476E-11	1.964E-11
26	2.530E-11	1.967E-11	1.230E-11
27	2.651E-11	2.463E-11	1.509E-11
28	1.801E-11	1.791E-11	1.138E-11
29	1.512E-11	1.987E-11	1.503E-11
30	1.751E-11	2.042E-11	1.633E-11
31	2.377E-11	1.983E-11	1.676E-11
32	1.722E-11	1.442E-11	1.795E-11
33	1.603E-11	2.082E-11	1.785E-11
34	2.139E-11	1.989E-11	1.764E-11
35	1.753E-11	1.959E-11	1.810E-11
36	1.508E-11	1.487E-11	1.265E-11
37	8.792E-12	8.060E-12	5.547E-12

ENERGY GROUP	BIN 7 RESPONSE	BIN 8 RESPONSE	BIN 9 RESPONSE
1	3.367E-10	5.734E-10	4.257E-10
2	3.591E-10	6.318E-10	4.173E-10
3	3.389E-10	4.900E-10	3.649E-10
4	2.993E-10	5.301E-10	3.930E-10
5	2.980E-10	5.445E-10	3.929E-10
6	2.708E-10	5.223E-10	3.656E-10
7	2.892E-10	5.415E-10	3.915E-10
8	2.574E-10	4.841E-10	3.716E-10
9	2.312E-10	5.109E-10	3.129E-10
10	2.417E-10	3.958E-10	2.917E-10
11	1.774E-10	4.584E-10	2.727E-10
12	2.248E-10	3.909E-10	2.944E-10
13	1.724E-10	3.532E-10	2.454E-10
14	1.282E-10	3.816E-10	2.145E-10
15	1.297E-10	3.294E-10	2.117E-10
16	1.245E-10	2.842E-10	1.580E-10
17	8.074E-11	1.896E-10	1.090E-10
18	6.437E-11	2.313E-10	1.340E-10
19	7.854E-11	1.921E-10	1.261E-10
20	3.610E-11	1.994E-10	7.411E-11
21	1.719E-11	1.111E-10	6.281E-11
22	1.360E-11	5.382E-11	2.767E-11
23	8.959E-12	4.504E-11	1.511E-11
24	8.429E-12	3.863E-11	1.004E-11
25	7.947E-12	2.453E-11	9.945E-12
26	1.070E-11	1.912E-11	7.800E-12
27	7.259E-12	1.932E-11	1.162E-11
28	1.081E-11	1.593E-11	9.594E-12
29	4.170E-12	2.960E-11	1.229E-11
30	5.919E-12	3.769E-11	9.817E-12
31	8.177E-12	2.417E-11	1.525E-11
32	1.014E-11	1.883E-11	1.568E-11
33	5.984E-12	2.746E-11	1.402E-11
34	5.213E-12	2.525E-11	1.545E-11
35	5.264E-12	3.478E-11	2.137E-11
36	8.161E-12	2.530E-11	5.918E-12
37	1.686E-12	1.036E-11	6.013E-12

ENERGY GROUP	BIN 10 RESPONSE	BIN 11 RESPONSE	BIN 12 RESPONSE
1	3.006E-10	5.758E-10	2.207E-10
2	2.972E-10	4.864E-10	2.141E-10
3	2.654E-10	5.418E-10	1.977E-10
4	2.591E-10	4.783E-10	1.822E-10
5	2.503E-10	4.656E-10	1.726E-10
6	2.230E-10	4.971E-10	1.980E-10
7	2.471E-10	4.374E-10	1.894E-10
8	2.370E-10	4.226E-10	1.657E-10
9	2.112E-10	4.356E-10	1.458E-10
10	1.753E-10	3.910E-10	1.447E-10
11	1.736E-10	3.781E-10	1.230E-10
12	1.749E-10	3.594E-10	1.226E-10
13	1.345E-10	2.691E-10	1.186E-10
14	1.343E-10	2.500E-10	8.882E-11
15	1.102E-10	2.798E-10	7.119E-11
16	7.024E-11	2.109E-10	6.468E-11
17	6.904E-11	1.715E-10	4.524E-11
18	6.275E-11	1.922E-10	4.196E-11
19	6.064E-11	1.302E-10	3.344E-11
20	3.382E-11	1.082E-10	2.950E-11
21	1.801E-11	6.518E-11	1.503E-11
22	1.466E-11	3.734E-11	8.833E-12
23	5.864E-12	2.459E-11	6.327E-12
24	6.914E-12	2.369E-11	4.115E-12
25	7.785E-12	2.233E-11	4.010E-12
26	9.765E-12	1.141E-11	3.502E-12
27	4.708E-12	1.149E-11	4.147E-12
28	6.442E-12	1.417E-11	1.791E-12
29	7.145E-12	1.180E-11	4.914E-12
30	5.477E-12	1.264E-11	5.981E-12
31	6.828E-12	8.791E-12	3.046E-12
32	7.108E-12	2.047E-11	5.045E-12
33	6.430E-12	1.340E-11	2.824E-12
34	2.415E-12	1.621E-11	3.652E-12
35	7.156E-12	1.397E-11	2.274E-12
36	5.374E-12	8.820E-12	3.713E-13
37	2.162E-12	7.446E-12	1.597E-12

AZIMUTHAL AND POLAR ANGLE-DIFFERENTIAL DOSE

DEPOSITION FACTORS

Gamma Ray Dose Deposition From Incident Gamma Ray Fluence (γ-γ)

PELVIS

ENERGY	BIN 1		BIN 2		BIN 3	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.542E-10*	.108	2.343E-10	.095	1.654E-10	.100
2	8.826E-11	.131	1.598E-10	.104	1.339E-10	.118
3	9.164E-11	.142	1.642E-10	.111	1.145E-10	.120
4	6.612E-11	.163	1.297E-10	.120	8.855E-11	.132
5	5.320E-11	.178	1.049E-10	.141	9.591E-11	.125
6	4.642E-11	.210	8.918E-11	.147	8.855E-11	.140
7	3.933E-11	.197	8.413E-11	.143	5.064E-11	.182
8	3.756E-11	.203	6.136E-11	.155	4.613E-11	.191
9	3.089E-11	.153	4.205E-11	.147	4.310E-11	.158
10	1.917E-11	.222	5.262E-11	.127	3.542E-11	.161
11	2.463E-11	.190	3.779E-11	.159	2.908E-11	.188
12	1.316E-11	.171	2.174E-11	.130	1.902E-11	.161
13	5.796E-12	.263	2.051E-11	.154	1.013E-11	.218
14	3.808E-12	.274	1.080E-11	.226	5.548E-12	.231
15	1.856E-12	.371	8.407E-12	.191	3.193E-12	.247
16	1.198E-12	.272	3.408E-12	.164	1.765E-12	.233
17	4.727E-13	.449	3.362E-12	.176	2.083E-12	.227
18	8.785E-13	.344	3.250E-12	.187	7.749E-13	.363
19	1.807E-13	.464	1.444E-12	.222	4.522E-13	.364
20	3.179E-14	1.000	6.598E-13	.661	4.295E-14	1.000
21	0.	0.000	0.	0.000	0.	0.000

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.210E-10	.087	2.204E-10	.093	2.259E-10	.089
2	1.608E-10	.111	1.853E-10	.105	1.480E-10	.116
3	1.409E-10	.111	1.274E-10	.122	1.255E-10	.121
4	1.084E-10	.132	1.251E-10	.138	1.029E-10	.135
5	1.141E-10	.135	1.376E-10	.120	1.188E-10	.124
6	1.167E-10	.131	1.426E-10	.116	9.850E-11	.134
7	7.682E-11	.156	8.508E-11	.134	7.983E-11	.145
8	8.813E-11	.144	7.780E-11	.162	6.017E-11	.161
9	6.571E-11	.117	5.058E-11	.132	5.706E-11	.136
10	5.076E-11	.126	4.962E-11	.138	5.348E-11	.117
11	2.910E-11	.164	3.638E-11	.147	4.552E-11	.140
12	2.123E-11	.148	2.769E-11	.130	2.674E-11	.132
13	1.700E-11	.151	2.333E-11	.122	1.851E-11	.138
14	1.148E-11	.143	1.441E-11	.127	1.545E-11	.172
15	7.849E-12	.175	7.219E-12	.159	5.471E-12	.161
16	3.005E-12	.196	4.811E-12	.144	6.105E-12	.129
17	3.297E-12	.174	3.429E-12	.174	3.470E-12	.161
18	3.010E-12	.175	2.114E-12	.190	2.631E-12	.199
19	2.128E-12	.174	2.688E-12	.171	1.549E-12	.207
20	7.574E-13	.581	8.542E-14	.820	0.	0.000
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.716E-10	.105	2.520E-10	.087	2.018E-10	.089
2	1.258E-10	.119	2.020E-10	.096	1.441E-10	.123
3	1.097E-10	.125	1.361E-10	.117	1.407E-10	.114
4	1.215E-10	.123	1.329E-10	.129	1.344E-10	.116
5	1.211E-10	.116	1.082E-10	.132	8.558E-11	.147
6	1.040E-10	.128	9.316E-11	.137	7.917E-11	.151
7	6.527E-11	.155	7.294E-11	.162	8.348E-11	.140
8	3.691E-11	.211	6.180E-11	.163	5.776E-11	.173
9	4.827E-11	.141	6.944E-11	.113	5.523E-11	.124
10	3.487E-11	.153	4.816E-11	.137	3.885E-11	.143
11	1.689E-11	.224	4.603E-11	.129	3.181E-11	.169
12	1.885E-11	.188	2.517E-11	.138	1.705E-11	.145
13	5.048E-12	.323	1.950E-11	.131	2.103E-11	.126
14	4.637E-12	.265	1.744E-11	.159	1.057E-11	.155
15	3.427E-12	.221	9.056E-12	.140	6.908E-12	.137
16	1.274E-12	.244	4.931E-12	.137	4.533E-12	.147
17	1.493E-12	.261	4.314E-12	.167	3.003E-12	.190
18	1.302E-12	.317	3.147E-12	.151	1.664E-12	.236
19	3.926E-13	.412	2.594E-12	.177	1.228E-12	.234
20	1.093E-13	.854	9.931E-13	.500	7.474E-14	.713
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 10 RESPONSE	BIN 10 FSD	BIN 11 RESPONSE	BIN 11 FSD	BIN 12 RESPONSE	BIN 12 FSD
1	1.780E-10	.103	2.166E-10	.089	1.405E-10	.099
2	1.213E-10	.121	1.611E-10	.103	1.236E-10	.125
3	1.148E-10	.143	1.335E-10	.117	1.171E-10	.137
4	9.517E-11	.137	1.228E-10	.127	8.221E-11	.147
5	1.048E-10	.136	1.375E-10	.115	9.431E-11	.137
6	9.665E-11	.125	1.063E-10	.134	6.758E-11	.153
7	7.038E-11	.151	9.758E-11	.158	5.058E-11	.169
8	5.928E-11	.157	7.883E-11	.138	3.754E-11	.223
9	4.058E-11	.148	5.026E-11	.139	3.574E-11	.163
10	3.994E-11	.140	4.800E-11	.147	2.751E-11	.163
11	2.615E-11	.218	3.768E-11	.156	1.443E-11	.213
12	1.765E-11	.150	3.360E-11	.120	1.335E-11	.195
13	7.606E-12	.206	1.993E-11	.146	1.387E-11	.317
14	4.492E-12	.225	8.660E-12	.158	5.182E-12	.305
15	3.441E-12	.261	6.607E-12	.164	1.215E-12	.273
16	1.598E-12	.229	4.440E-12	.151	1.161E-12	.262
17	9.326E-13	.314	4.175E-12	.153	1.450E-12	.277
18	1.156E-12	.294	2.379E-12	.211	1.113E-12	.280
19	6.658E-13	.297	9.668E-13	.246	3.654E-13	.425
20	1.747E-14	1.000	8.282E-14	.839	1.487E-14	1.000
21	0.	0.000	0.	0.000	0.	0.000

(γ-γ)

SPINE

ENERGY	BIN 1		BIN 2		BIN 3	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.925E-10	.113	1.781E-10	.108	1.535E-10	.105
2	1.198E-10	.137	1.680E-10	.102	1.490E-10	.108
3	1.258E-10	.133	1.207E-10	.138	1.167E-10	.116
4	9.294E-11	.140	9.132E-11	.141	1.108E-10	.131
5	1.020E-10	.133	1.034E-10	.143	9.996E-11	.129
6	6.448E-11	.156	1.072E-10	.132	7.362E-11	.158
7	5.934E-11	.193	8.806E-11	.134	7.692E-11	.149
8	4.127E-11	.188	5.562E-11	.167	5.917E-11	.172
9	3.886E-11	.150	4.528E-11	.135	4.941E-11	.136
10	3.402E-11	.162	3.775E-11	.164	3.401E-11	.156
11	2.625E-11	.180	2.643E-11	.176	2.977E-11	.181
12	1.606E-11	.166	2.376E-11	.130	1.766E-11	.155
13	1.101E-11	.182	1.418E-11	.166	1.408E-11	.156
14	4.175E-12	.244	8.411E-12	.178	8.850E-12	.183
15	4.365E-12	.335	5.257E-12	.236	3.123E-12	.224
16	1.006E-12	.305	2.641E-12	.187	1.577E-12	.226
17	1.385E-12	.264	1.591E-12	.239	1.479E-12	.273
18	9.697E-13	.320	1.111E-12	.267	7.053E-13	.364
19	3.618E-13	.439	9.063E-13	.337	4.887E-13	.507
20	3.615E-14	.705	6.651E-13	.696	0.	0.000
21	0.	0.000	0.	0.000	0.	0.000

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.944E-10	.098	1.714E-10	.111	2.114E-10	.095
2	2.000E-10	.098	1.486E-10	.109	1.633E-10	.098
3	1.670E-10	.114	1.379E-10	.122	1.497E-10	.117
4	1.640E-10	.109	9.665E-11	.137	1.192E-10	.126
5	1.256E-10	.127	1.122E-10	.125	1.119E-10	.130
6	8.472E-11	.137	1.041E-10	.127	8.140E-11	.156
7	8.799E-11	.143	7.895E-11	.150	7.450E-11	.150
8	9.873E-11	.158	5.495E-11	.184	5.369E-11	.191
9	6.521E-11	.123	5.121E-11	.131	5.595E-11	.124
10	6.405E-11	.114	4.227E-11	.144	4.473E-11	.141
11	4.813E-11	.146	3.749E-11	.157	3.185E-11	.146
12	3.013E-11	.130	2.357E-11	.136	1.833E-11	.151
13	2.398E-11	.136	1.454E-11	.163	1.959E-11	.219
14	1.570E-11	.122	1.154E-11	.174	9.219E-12	.167
15	8.439E-12	.138	8.060E-12	.206	5.371E-12	.206
16	5.473E-12	.129	3.958E-12	.150	2.104E-12	.194
17	3.287E-12	.182	3.040E-12	.197	1.872E-12	.220
18	3.229E-12	.165	2.908E-12	.186	8.032E-13	.337
19	1.480E-12	.206	1.590E-12	.237	4.626E-13	.403
20	6.789E-13	.683	9.553E-13	.530	0.	0.000
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.859E-10	.095	2.402E-10	.095	1.915E-10	.101
2	1.625E-10	.098	1.392E-10	.125	1.714E-10	.104
3	1.268E-10	.107	1.463E-10	.118	1.210E-10	.124
4	1.111E-10	.123	1.438E-10	.126	9.971E-11	.134
5	1.020E-10	.126	1.313E-10	.118	1.042E-10	.136
6	1.148E-10	.110	1.017E-10	.155	1.021E-10	.117
7	9.220E-11	.133	7.991E-11	.151	6.610E-11	.147
8	5.993E-11	.169	7.794E-11	.146	6.379E-11	.172
9	5.256E-11	.126	6.392E-11	.121	4.943E-11	.138
10	3.554E-11	.159	4.139E-11	.160	3.203E-11	.168
11	3.200E-11	.175	4.759E-11	.143	2.265E-11	.199
12	2.456E-11	.128	2.942E-11	.113	1.368E-11	.178
13	1.807E-11	.155	1.965E-11	.144	8.786E-12	.202
14	1.045E-11	.161	1.757E-11	.132	5.968E-12	.211
15	4.850E-12	.175	8.749E-12	.122	3.042E-12	.209
16	3.193E-12	.146	6.292E-12	.123	1.777E-12	.213
17	1.725E-12	.244	6.196E-12	.115	1.275E-12	.320
18	1.569E-12	.225	3.847E-12	.145	9.233E-13	.316
19	5.199E-13	.371	3.569E-12	.154	4.313E-13	.431
20	2.009E-14	1.000	3.645E-13	.612	1.747E-14	1.000
21	0.	0.000	0.	0.000	0.	0.000

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.818E-10	.098	2.531E-10	.079	1.878E-10	.099
2	1.669E-10	.124	1.636E-10	.113	1.142E-10	.124
3	9.678E-11	.149	1.457E-10	.123	6.061E-11	.148
4	8.316E-11	.144	1.611E-10	.106	7.651E-11	.163
5	9.239E-11	.132	1.202E-10	.115	8.078E-11	.137
6	7.999E-11	.140	7.996E-11	.159	5.077E-11	.174
7	6.353E-11	.160	7.910E-11	.158	5.824E-11	.180
8	4.646E-11	.193	7.717E-11	.160	3.690E-11	.202
9	4.365E-11	.150	6.331E-11	.118	3.724E-11	.166
10	3.317E-11	.157	5.661E-11	.114	2.524E-11	.178
11	2.365E-11	.193	3.278E-11	.179	1.540E-11	.286
12	1.591E-11	.153	2.728E-11	.126	8.893E-12	.204
13	1.057E-11	.202	1.823E-11	.137	4.125E-12	.284
14	5.567E-12	.203	1.198E-11	.140	4.010E-12	.252
15	2.169E-12	.294	7.174E-12	.152	2.118E-12	.327
16	2.221E-12	.193	4.620E-12	.136	7.235E-13	.367
17	1.145E-12	.310	4.494E-12	.143	3.141E-13	.589
18	8.009E-13	.363	3.904E-12	.156	5.932E-13	.362
19	1.912E-13	.744	2.025E-12	.192	1.261E-13	.471
20	0.	0.000	5.114E-13	.839	9.483E-14	.599
21	0.	0.000	0.	0.000	0.	0.000

(γ-γ)

SKULL

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	2.329E-10	.095	2.141E-10	.091	2.034E-10	.106
2	1.793E-10	.098	1.535E-10	.111	1.748E-10	.121
3	1.466E-10	.115	1.810E-10	.102	1.553E-10	.113
4	1.285E-10	.123	1.710E-10	.100	1.170E-10	.125
5	1.300E-10	.111	1.404E-10	.123	1.396E-10	.116
6	1.281E-10	.121	1.019E-10	.140	9.505E-11	.144
7	1.058E-10	.150	6.402E-11	.180	5.676E-11	.183
8	7.782E-11	.161	7.020E-11	.167	7.094E-11	.164
9	7.704E-11	.118	7.639E-11	.114	6.982E-11	.120
10	6.294E-11	.120	5.415E-11	.124	3.930E-11	.159
11	4.516E-11	.150	4.180E-11	.142	5.081E-11	.134
12	2.864E-11	.122	3.042E-11	.112	2.284E-11	.141
13	2.456E-11	.118	2.012E-11	.113	1.971E-11	.127
14	1.169E-11	.145	1.687E-11	.110	1.552E-11	.142
15	8.273E-12	.112	9.632E-12	.105	5.800E-12	.198
16	5.870E-12	.123	5.623E-12	.135	2.904E-12	.171
17	3.220E-12	.170	4.532E-12	.144	3.489E-12	.157
18	3.336E-12	.196	5.274E-12	.134	2.430E-12	.183
19	4.186E-12	.139	5.468E-12	.129	2.329E-12	.207
20	2.889E-12	.335	4.010E-12	.293	6.502E-13	.670
21	6.368E-12	.567	2.414E-13	.536	2.172E-12	.966

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.192E-10	.098	2.561E-10	.086	2.441E-10	.090
2	2.080E-10	.102	2.172E-10	.095	1.849E-10	.103
3	1.885E-10	.105	1.488E-10	.113	1.076E-10	.143
4	1.173E-10	.122	1.388E-10	.115	1.375E-10	.118
5	1.258E-10	.116	1.408E-10	.123	1.155E-10	.128
6	1.060E-10	.142	8.494E-11	.156	9.186E-11	.151
7	1.018E-10	.141	1.276E-10	.132	9.039E-11	.142
8	7.575E-11	.155	6.692E-11	.165	4.659E-11	.186
9	5.700E-11	.123	6.067E-11	.126	6.144E-11	.131
10	5.164E-11	.132	5.725E-11	.130	3.895E-11	.152
11	4.675E-11	.132	5.095E-11	.136	3.722E-11	.154
12	3.607E-11	.106	3.422E-11	.120	3.271E-11	.104
13	2.430E-11	.114	2.760E-11	.106	2.230E-11	.136
14	1.776E-11	.130	1.441E-11	.126	1.093E-11	.144
15	9.240E-12	.120	1.192E-11	.106	6.289E-12	.151
16	5.132E-12	.135	6.285E-12	.125	4.255E-12	.151
17	4.191E-12	.153	5.129E-12	.140	2.370E-12	.205
18	4.205E-12	.142	6.061E-12	.124	2.072E-12	.209
19	4.310E-12	.143	5.586E-12	.126	1.857E-12	.221
20	3.952E-12	.300	5.452E-12	.244	1.814E-12	.460
21	2.172E-12	.966	6.368E-12	.567	2.664E-13	1.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	2.035E-10	.114	2.434E-10	.090	2.387E-10	.083
2	1.798E-10	.099	1.436E-10	.118	1.896E-10	.108
3	1.389E-10	.115	1.699E-10	.108	1.685E-10	.103
4	1.429E-10	.115	1.430E-10	.115	1.229E-10	.139
5	1.236E-10	.113	1.125E-10	.128	1.210E-10	.122
6	8.892E-11	.149	1.032E-10	.140	1.027E-10	.134
7	5.203E-11	.171	1.068E-10	.129	7.482E-11	.151
8	6.582E-11	.172	9.746E-11	.129	6.706E-11	.165
9	6.409E-11	.131	5.873E-11	.139	5.051E-11	.129
10	3.968E-11	.146	5.662E-11	.120	5.329E-11	.141
11	2.600E-11	.179	3.271E-11	.180	3.965E-11	.148
12	2.380E-11	.122	3.212E-11	.111	2.823E-11	.133
13	1.483E-11	.160	1.879E-11	.130	1.882E-11	.115
14	1.113E-11	.143	1.881E-11	.107	9.325E-12	.143
15	7.410E-12	.191	8.181E-12	.124	6.312E-12	.165
16	2.127E-12	.202	5.596E-12	.127	4.204E-12	.146
17	1.914E-12	.226	4.577E-12	.143	3.237E-12	.173
18	2.549E-12	.187	3.438E-12	.168	2.589E-12	.199
19	1.314E-12	.239	3.310E-12	.174	2.364E-12	.195
20	3.925E-13	.705	5.002E-12	.295	1.082E-12	.556
21	0.	0.000	1.423E-13	.620	2.172E-12	.966

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	1.779E-10	.095	1.972E-10	.102	1.742E-10	.099
2	1.294E-10	.125	1.623E-10	.112	1.208E-10	.128
3	1.217E-10	.117	1.404E-10	.131	1.039E-10	.153
4	9.964E-11	.145	1.242E-10	.118	8.905E-11	.163
5	6.993E-11	.157	1.132E-10	.122	5.868E-11	.163
6	6.836E-11	.160	1.115E-10	.140	6.187E-11	.167
7	7.638E-11	.148	7.454E-11	.155	5.058E-11	.187
8	3.038E-11	.220	7.193E-11	.162	3.565E-11	.196
9	4.860E-11	.142	6.139E-11	.111	3.478E-11	.167
10	4.227E-11	.151	4.599E-11	.137	2.036E-11	.214
11	3.323E-11	.158	5.005E-11	.136	1.520E-11	.236
12	1.379E-11	.161	2.238E-11	.130	7.587E-12	.223
13	9.661E-12	.191	1.958E-11	.118	4.329E-12	.267
14	6.880E-12	.187	1.213E-11	.224	4.258E-12	.231
15	3.515E-12	.223	6.772E-12	.150	1.772E-12	.304
16	2.120E-12	.232	3.454E-12	.169	8.354E-13	.354
17	1.060E-12	.303	2.487E-12	.191	6.945E-13	.354
18	2.146E-13	.570	2.350E-12	.211	8.612E-13	.318
19	3.538E-13	.495	2.266E-12	.216	5.710E-13	.393
20	0.	0.000	2.195E-12	.423	0.	0.000
21	0.	0.000	1.493E-13	.705	0.	0.000

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.991E-10	.103	1.901E-10	.106	2.105E-10	.101
2	1.371E-10	.116	1.723E-10	.111	1.681E-10	.109
3	1.402E-10	.105	1.374E-10	.129	1.455E-10	.103
4	1.219E-10	.124	1.557E-10	.106	9.489E-11	.133
5	9.680E-11	.138	1.023E-10	.138	8.755E-11	.146
6	9.521E-11	.134	1.076E-10	.127	1.006E-10	.126
7	6.675E-11	.162	7.386E-11	.175	5.758E-11	.191
8	7.208E-11	.160	8.338E-11	.154	5.994E-11	.168
9	5.185E-11	.132	6.286E-11	.126	6.152E-11	.138
10	4.816E-11	.140	6.425E-11	.121	4.657E-11	.151
11	3.012E-11	.191	4.936E-11	.127	1.785E-11	.235
12	2.161E-11	.135	3.180E-11	.123	2.372E-11	.132
13	1.584E-11	.154	2.220E-11	.122	1.067E-11	.165
14	9.553E-12	.155	1.559E-11	.134	9.979E-12	.157
15	5.648E-12	.283	8.236E-12	.140	4.512E-12	.188
16	2.937E-12	.174	4.820E-12	.139	3.127E-12	.178
17	1.874E-12	.217	4.697E-12	.144	3.154E-12	.174
18	2.672E-12	.184	3.366E-12	.161	1.754E-12	.226
19	1.992E-12	.206	4.098E-12	.150	2.562E-12	.189
20	2.208E-12	.395	3.972E-12	.297	2.409E-12	.464
21	0.	0.000	4.196E-12	.705	3.494E-14	.705

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.259E-10	.096	2.175E-10	.108	1.986E-10	.098
2	1.865E-10	.108	2.155E-10	.103	1.530E-10	.105
3	1.617E-10	.121	1.334E-10	.128	1.122E-10	.123
4	1.222E-10	.115	1.234E-10	.123	1.337E-10	.115
5	1.247E-10	.121	1.158E-10	.129	1.017E-10	.129
6	1.088E-10	.129	9.172E-11	.134	1.072E-10	.129
7	8.995E-11	.166	7.606E-11	.159	9.942E-11	.138
8	6.596E-11	.163	7.000E-11	.150	6.693E-11	.150
9	6.417E-11	.127	7.764E-11	.116	6.117E-11	.129
10	5.890E-11	.126	6.639E-11	.131	4.083E-11	.156
11	5.200E-11	.182	3.391E-11	.186	4.139E-11	.137
12	2.819E-11	.125	3.041E-11	.118	2.583E-11	.116
13	1.788E-11	.136	2.383E-11	.126	2.689E-11	.116
14	1.313E-11	.118	1.551E-11	.116	1.242E-11	.151
15	8.287E-12	.151	7.964E-12	.143	8.175E-12	.141
16	4.975E-12	.137	5.327E-12	.128	5.584E-12	.129
17	3.177E-12	.177	3.964E-12	.153	3.286E-12	.168
18	2.682E-12	.180	3.957E-12	.155	3.467E-12	.153
19	3.892E-12	.156	3.982E-12	.154	3.124E-12	.185
20	4.642E-12	.300	1.917E-12	.361	4.664E-12	.269
21	4.196E-12	.705	0.	0.000	2.664E-13	1.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	2.415E-10	.096	1.678E-10	.119	2.019E-10	.095
2	1.355E-10	.115	1.740E-10	.102	1.801E-10	.102
3	1.187E-10	.128	1.621E-10	.117	1.542E-10	.108
4	9.630E-11	.149	1.357E-10	.121	1.358E-10	.112
5	1.203E-10	.117	1.391E-10	.119	1.114E-10	.146
6	8.005E-11	.154	1.495E-10	.117	9.812E-11	.139
7	7.699E-11	.151	8.226E-11	.158	9.222E-11	.139
8	4.268E-11	.188	5.761E-11	.183	7.020E-11	.159
9	4.373E-11	.153	5.450E-11	.127	5.881E-11	.128
10	2.934E-11	.168	6.025E-11	.125	3.805E-11	.157
11	2.836E-11	.188	3.309E-11	.175	3.471E-11	.152
12	2.187E-11	.133	3.110E-11	.129	3.502E-11	.121
13	1.257E-11	.200	2.128E-11	.110	1.937E-11	.125
14	7.815E-12	.178	1.371E-11	.120	1.017E-11	.142
15	6.180E-12	.158	8.342E-12	.153	8.028E-12	.135
16	3.259E-12	.169	6.136E-12	.156	3.814E-12	.159
17	2.064E-12	.223	4.404E-12	.148	3.083E-12	.212
18	2.514E-12	.190	4.013E-12	.159	2.596E-12	.193
19	1.775E-12	.225	4.799E-12	.137	3.652E-12	.154
20	1.082E-12	.558	5.226E-12	.258	2.788E-12	.333
21	0.	0.000	0.	0.000	3.382E-14	1.000

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	2.145E-10	.101	2.304E-10	.089	1.651E-10	.113
2	1.481E-10	.106	1.658E-10	.104	1.688E-10	.099
3	1.283E-10	.128	1.591E-10	.118	8.205E-11	.151
4	1.221E-10	.120	1.257E-10	.120	7.387E-11	.150
5	1.118E-10	.135	1.236E-10	.129	8.530E-11	.141
6	9.105E-11	.160	1.030E-10	.134	7.310E-11	.149
7	7.267E-11	.153	8.391E-11	.142	6.718E-11	.165
8	5.873E-11	.183	6.700E-11	.161	5.269E-11	.183
9	5.100E-11	.144	5.890E-11	.129	4.967E-11	.137
10	3.728E-11	.164	4.753E-11	.137	3.187E-11	.172
11	2.240E-11	.187	2.858E-11	.160	2.261E-11	.183
12	1.945E-11	.152	3.221E-11	.107	1.851E-11	.157
13	1.193E-11	.157	2.054E-11	.125	1.305E-11	.158
14	9.468E-12	.162	1.196E-11	.125	5.929E-12	.186
15	6.973E-12	.227	6.655E-12	.156	3.321E-12	.206
16	2.432E-12	.206	4.681E-12	.142	2.148E-12	.205
17	1.686E-12	.245	4.037E-12	.152	1.636E-12	.251
18	1.617E-12	.280	2.622E-12	.174	1.250E-12	.318
19	2.213E-12	.212	3.436E-12	.173	2.080E-12	.206
20	1.865E-12	.407	4.266E-12	.290	1.741E-12	.419
21	0.	0.000	7.464E-14	1.000	0.	0.000

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SCAPULA

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	2.113E-10	.097	2.341E-10	.085	1.712E-10	.105
2	1.223E-10	.123	1.599E-10	.119	1.652E-10	.102
3	1.503E-10	.110	1.545E-10	.108	1.334E-10	.133
4	1.079E-10	.136	1.342E-10	.111	9.888E-11	.128
5	1.166E-10	.146	1.696E-10	.115	8.610E-11	.144
6	7.875E-11	.151	9.926E-11	.132	9.775E-11	.151
7	6.867E-11	.157	6.459E-11	.174	5.321E-11	.173
8	6.351E-11	.166	6.403E-11	.162	4.626E-11	.197
9	6.377E-11	.120	6.144E-11	.132	4.504E-11	.143
10	4.104E-11	.147	4.548E-11	.153	2.768E-11	.178
11	2.344E-11	.214	3.436E-11	.165	2.524E-11	.180
12	2.661E-11	.125	2.403E-11	.139	1.643E-11	.167
13	1.561E-11	.146	1.917E-11	.121	9.059E-12	.283
14	1.060E-11	.151	1.065E-11	.148	4.553E-12	.227
15	4.551E-12	.180	7.443E-12	.136	3.935E-12	.265
16	2.612E-12	.218	3.713E-12	.155	1.684E-12	.221
17	2.104E-12	.218	3.126E-12	.168	1.192E-12	.286
18	2.190E-12	.208	2.248E-12	.215	6.350E-13	.397
19	9.543E-13	.265	3.114E-12	.180	3.607E-13	.508
20	7.756E-13	.612	2.730E-12	.371	1.747E-14	1.000
21	2.098E-12	1.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.518E-10	.090	2.549E-10	.078	2.159E-10	.097
2	1.561E-10	.111	1.831E-10	.108	1.507E-10	.106
3	1.475E-10	.111	1.425E-10	.109	1.666E-10	.125
4	1.506E-10	.120	1.191E-10	.123	1.334E-10	.119
5	1.241E-10	.124	1.485E-10	.118	1.104E-10	.134
6	1.302E-10	.122	1.007E-10	.147	8.188E-11	.148
7	1.109E-10	.120	8.740E-11	.152	7.297E-11	.159
8	8.863E-11	.137	7.290E-11	.149	6.021E-11	.183
9	6.136E-11	.133	7.515E-11	.117	4.506E-11	.142
10	6.218E-11	.131	6.070E-11	.126	5.519E-11	.126
11	6.182E-11	.125	3.999E-11	.188	3.551E-11	.150
12	4.385E-11	.120	3.792E-11	.104	2.803E-11	.132
13	2.907E-11	.109	2.509E-11	.123	1.635E-11	.176
14	1.948E-11	.110	1.898E-11	.114	8.933E-12	.177
15	1.071E-11	.106	1.211E-11	.127	4.765E-12	.176
16	6.656E-12	.137	6.388E-12	.127	3.222E-12	.166
17	5.590E-12	.142	3.966E-12	.149	1.852E-12	.226
18	4.675E-12	.140	4.628E-12	.155	1.569E-12	.272
19	6.878E-12	.108	4.629E-12	.138	1.211E-12	.239
20	6.063E-12	.240	3.651E-12	.295	0.	0.000
21	2.364E-12	.894	3.002E-13	.894	0.	0.000

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.758E-10	.115	2.544E-10	.091	2.329E-10	.094
2	1.417E-10	.114	2.404E-10	.085	1.646E-10	.106
3	1.206E-10	.117	1.500E-10	.110	1.346E-10	.116
4	8.792E-11	.142	1.543E-10	.110	1.231E-10	.137
5	7.893E-11	.149	1.549E-10	.119	1.059E-10	.131
6	9.598E-11	.122	1.012E-10	.143	9.009E-11	.148
7	7.536E-11	.167	8.420E-11	.154	6.317E-11	.167
8	6.816E-11	.172	8.301E-11	.159	5.932E-11	.172
9	4.812E-11	.140	7.199E-11	.123	7.020E-11	.116
10	3.506E-11	.163	6.170E-11	.141	4.687E-11	.147
11	2.695E-11	.218	4.529E-11	.140	3.748E-11	.160
12	1.769E-11	.144	3.460E-11	.108	2.936E-11	.114
13	1.160E-11	.185	3.254E-11	.100	2.016E-11	.127
14	7.424E-12	.175	2.293E-11	.108	1.382E-11	.145
15	2.482E-12	.240	1.186E-11	.129	5.785E-12	.156
16	1.714E-12	.231	5.785E-12	.120	4.355E-12	.140
17	1.041E-12	.325	6.958E-12	.125	3.651E-12	.154
18	1.108E-12	.279	5.731E-12	.133	1.901E-12	.209
19	6.244E-13	.390	7.367E-12	.110	3.810E-12	.171
20	1.582E-14	1.000	1.086E-11	.188	2.517E-12	.381
21	0.	0.000	1.356E-11	.373	2.098E-12	1.000

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.623E-10	.106	2.616E-10	.092	1.632E-10	.119
2	1.286E-10	.113	1.911E-10	.096	1.394E-10	.129
3	1.089E-10	.136	1.661E-10	.112	1.450E-10	.109
4	1.086E-10	.127	1.493E-10	.126	1.091E-10	.126
5	8.151E-11	.149	1.608E-10	.104	7.030E-11	.152
6	7.116E-11	.166	9.268E-11	.136	4.831E-11	.190
7	8.020E-11	.169	8.759E-11	.157	5.074E-11	.205
8	5.005E-11	.194	8.573E-11	.150	5.314E-11	.194
9	2.761E-11	.183	6.250E-11	.141	4.316E-11	.150
10	2.327E-11	.194	6.369E-11	.120	4.019E-11	.164
11	2.166E-11	.209	5.555E-11	.133	3.711E-11	.169
12	1.505E-11	.198	4.570E-11	.105	1.343E-11	.172
13	6.901E-12	.225	2.724E-11	.108	1.246E-11	.161
14	4.219E-12	.219	1.735E-11	.125	6.870E-12	.211
15	2.930E-12	.238	9.869E-12	.104	3.944E-12	.172
16	1.190E-12	.260	5.841E-12	.136	2.536E-12	.195
17	4.981E-13	.433	4.252E-12	.147	1.740E-12	.243
18	8.333E-13	.335	5.905E-12	.127	1.353E-12	.255
19	1.322E-13	.676	6.862E-12	.110	1.754E-12	.217
20	0.	0.000	4.838E-12	.249	7.330E-13	.638
21	0.	0.000	2.439E-12	.867	0.	0.000

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.056E-10	.125	1.801E-10	.100	1.784E-10	.107
2	1.104E-10	.139	1.427E-10	.119	1.338E-10	.112
3	9.424E-11	.139	1.808E-10	.109	9.455E-11	.141
4	7.846E-11	.155	1.381E-10	.122	1.351E-10	.117
5	6.467E-11	.155	1.270E-10	.115	8.844E-11	.128
6	6.657E-11	.160	8.962E-11	.152	5.600E-11	.167
7	4.780E-11	.167	8.274E-11	.142	5.446E-11	.171
8	3.602E-11	.205	5.543E-11	.170	5.773E-11	.184
9	3.514E-11	.154	6.514E-11	.116	3.824E-11	.147
10	2.439E-11	.184	3.703E-11	.147	4.153E-11	.150
11	1.335E-11	.261	1.894E-11	.193	2.076E-11	.199
12	5.483E-12	.253	2.502E-11	.133	1.591E-11	.161
13	4.567E-12	.261	1.760E-11	.163	1.412E-11	.280
14	3.168E-12	.309	9.275E-12	.186	6.963E-12	.223
15	1.417E-12	.376	6.057E-12	.191	3.320E-12	.231
16	9.372E-13	.296	4.017E-12	.153	2.114E-12	.205
17	1.120E-12	.296	2.052E-12	.223	1.440E-12	.266
18	3.272E-13	.579	2.100E-12	.214	1.315E-12	.247
19	1.462E-13	.499	1.025E-12	.258	4.581E-13	.370
20	0.	0.000	4.000E-13	.587	1.963E-13	1.000
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.084E-10	.103	1.947E-10	.100	2.366E-10	.087
2	1.378E-10	.121	1.871E-10	.100	1.643E-10	.110
3	1.308E-10	.120	1.615E-10	.099	1.680E-10	.105
4	1.158E-10	.127	1.082E-10	.142	1.315E-10	.122
5	1.118E-10	.128	1.046E-10	.124	1.069E-10	.130
6	7.947E-11	.167	1.031E-10	.130	1.050E-10	.136
7	6.722E-11	.171	8.164E-11	.146	8.147E-11	.147
8	4.746E-11	.173	6.564E-11	.163	6.399E-11	.170
9	5.968E-11	.122	5.234E-11	.138	6.160E-11	.134
10	4.658E-11	.139	4.924E-11	.133	4.959E-11	.132
11	3.777E-11	.159	3.476E-11	.154	4.214E-11	.141
12	2.392E-11	.136	2.833E-11	.123	3.507E-11	.112
13	1.981E-11	.174	1.835E-11	.142	2.702E-11	.102
14	9.874E-12	.178	1.396E-11	.138	1.542E-11	.205
15	7.276E-12	.177	6.271E-12	.137	7.395E-12	.175
16	3.931E-12	.153	3.754E-12	.158	3.969E-12	.146
17	2.967E-12	.163	1.943E-12	.223	4.159E-12	.160
18	2.787E-12	.211	3.537E-12	.167	3.256E-12	.156
19	1.523E-12	.241	2.296E-12	.169	1.995E-12	.201
20	3.256E-13	.668	1.549E-13	.665	1.378E-12	.475
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	1.521E-10	.108	2.565E-10	.092	2.357E-10	.090
2	1.368E-10	.105	1.683E-10	.108	1.529E-10	.106
3	1.307E-10	.117	1.437E-10	.111	1.372E-10	.121
4	1.039E-10	.127	1.339E-10	.108	1.284E-10	.114
5	1.043E-10	.139	1.168E-10	.119	1.337E-10	.127
6	9.541E-11	.140	8.764E-11	.144	8.903E-11	.139
7	6.277E-11	.152	8.464E-11	.147	8.857E-11	.138
8	5.291E-11	.174	7.185E-11	.144	7.670E-11	.150
9	6.400E-11	.107	5.115E-11	.122	5.527E-11	.128
10	4.091E-11	.146	4.678E-11	.135	4.264E-11	.145
11	2.049E-11	.207	3.161E-11	.177	3.582E-11	.161
12	1.611E-11	.161	3.275E-11	.103	2.206E-11	.132
13	1.508E-11	.168	1.789E-11	.140	1.392E-11	.149
14	6.822E-12	.195	1.674E-11	.164	1.228E-11	.143
15	4.727E-12	.197	9.176E-12	.122	7.318E-12	.152
16	1.968E-12	.204	5.254E-12	.127	4.437E-12	.146
17	1.906E-12	.213	3.445E-12	.168	3.372E-12	.209
18	1.203E-12	.246	3.328E-12	.163	2.709E-12	.207
19	4.284E-13	.481	1.420E-12	.224	1.522E-12	.224
20	5.888E-13	.574	4.056E-13	.528	5.076E-13	.837
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 10 RESPONSE	BIN 10 FSD	BIN 11 RESPONSE	BIN 11 FSD	BIN 12 RESPONSE	BIN 12 FSD
1	1.961E-10	.099	1.950E-10	.107	1.810E-10	.099
2	1.578E-10	.109	2.133E-10	.099	1.149E-10	.122
3	1.425E-10	.115	1.247E-10	.130	1.042E-10	.139
4	1.123E-10	.132	1.222E-10	.122	7.940E-11	.146
5	1.035E-10	.141	1.224E-10	.127	8.334E-11	.154
6	7.424E-11	.163	9.943E-11	.135	6.114E-11	.160
7	6.210E-11	.164	7.894E-11	.155	6.517E-11	.182
8	4.620E-11	.203	8.484E-11	.148	5.377E-11	.172
9	5.176E-11	.135	4.842E-11	.139	4.034E-11	.145
10	4.224E-11	.146	5.507E-11	.130	2.595E-11	.186
11	2.460E-11	.175	3.954E-11	.160	2.319E-11	.200
12	1.956E-11	.135	2.494E-11	.135	1.125E-11	.177
13	1.093E-11	.165	1.960E-11	.131	1.051E-11	.187
14	6.793E-12	.201	1.076E-11	.155	5.282E-12	.223
15	4.866E-12	.243	6.640E-12	.160	2.467E-12	.244
16	2.547E-12	.176	3.563E-12	.149	1.777E-12	.205
17	1.283E-12	.334	2.999E-12	.182	1.796E-12	.207
18	1.272E-12	.266	2.254E-12	.192	4.858E-13	.357
19	9.630E-13	.257	1.408E-12	.250	5.061E-13	.346
20	5.928E-14	.773	6.677E-13	.694	0.	0.000
21	0.	0.000	0.	0.000	0.	0.000

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	2.496E-10	.102	2.573E-10	.090	1.636E-10	.110
2	1.711E-10	.105	1.855E-10	.105	1.485E-10	.111
3	1.315E-10	.120	1.672E-10	.106	1.209E-10	.113
4	1.537E-10	.116	1.592E-10	.120	1.175E-10	.126
5	1.306E-10	.127	1.188E-10	.113	9.853E-11	.131
6	1.036E-10	.142	1.221E-10	.116	9.815E-11	.141
7	7.642E-11	.147	7.927E-11	.161	7.884E-11	.163
8	7.415E-11	.150	7.549E-11	.171	5.718E-11	.186
9	5.799E-11	.129	7.286E-11	.118	5.355E-11	.141
10	5.859E-11	.132	4.316E-11	.150	3.184E-11	.166
11	4.394E-11	.152	4.843E-11	.134	3.237E-11	.166
12	2.724E-11	.115	3.568E-11	.110	1.402E-11	.169
13	1.757E-11	.130	2.784E-11	.116	1.118E-11	.178
14	9.769E-12	.150	1.802E-11	.112	9.492E-12	.203
15	7.455E-12	.154	9.282E-12	.114	4.139E-12	.171
16	4.867E-12	.130	5.700E-12	.120	1.945E-12	.224
17	2.073E-12	.203	5.379E-12	.145	1.389E-12	.288
18	2.014E-12	.213	4.664E-12	.133	1.545E-12	.246
19	1.955E-12	.194	4.252E-12	.147	7.904E-13	.324
20	1.604E-12	.467	3.018E-12	.374	2.392E-13	.839
21	0.	0.000	2.664E-13	1.000	0.	0.000

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.009E-10	.107	2.330E-10	.096	2.142E-10	.093
2	1.804E-10	.103	2.133E-10	.099	1.861E-10	.105
3	1.363E-10	.123	1.615E-10	.110	1.827E-10	.127
4	1.768E-10	.106	1.220E-10	.132	1.468E-10	.127
5	1.033E-10	.130	1.214E-10	.129	1.082E-10	.126
6	1.050E-10	.129	1.055E-10	.131	1.042E-10	.127
7	9.182E-11	.145	1.093E-10	.134	6.510E-11	.172
8	8.216E-11	.155	7.216E-11	.153	8.429E-11	.160
9	6.313E-11	.123	7.556E-11	.120	7.039E-11	.120
10	4.838E-11	.147	7.058E-11	.120	5.533E-11	.136
11	3.556E-11	.149	5.009E-11	.146	5.605E-11	.131
12	2.662E-11	.126	3.310E-11	.122	3.170E-11	.116
13	1.881E-11	.130	2.656E-11	.101	2.358E-11	.116
14	1.500E-11	.119	1.951E-11	.104	1.254E-11	.131
15	7.912E-12	.122	1.045E-11	.152	7.800E-12	.127
16	3.952E-12	.160	6.215E-12	.114	5.728E-12	.135
17	2.606E-12	.190	4.680E-12	.130	3.985E-12	.165
18	3.502E-12	.167	7.013E-12	.105	2.806E-12	.165
19	2.581E-12	.186	4.854E-12	.134	2.398E-12	.178
20	9.039E-13	.527	4.311E-12	.285	3.626E-12	.312
21	0.	0.000	0.	0.000	0.	0.000

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.546E-10	.121	2.432E-10	.087	2.782E-10	.086
2	1.350E-10	.124	2.022E-10	.103	2.162E-10	.092
3	1.234E-10	.124	1.647E-10	.105	1.753E-10	.107
4	6.160E-11	.166	1.643E-10	.111	1.230E-10	.127
5	8.071E-11	.132	1.239E-10	.129	1.262E-10	.127
6	7.737E-11	.146	8.392E-11	.148	1.103E-10	.135
7	5.727E-11	.159	8.869E-11	.163	8.785E-11	.149
8	3.134E-11	.231	9.089E-11	.139	4.556E-11	.192
9	4.544E-11	.157	6.267E-11	.123	6.855E-11	.116
10	3.076E-11	.163	5.824E-11	.132	5.792E-11	.127
11	1.067E-11	.258	4.497E-11	.154	5.218E-11	.139
12	8.451E-12	.225	2.808E-11	.122	3.194E-11	.116
13	6.946E-12	.227	2.208E-11	.119	2.671E-11	.118
14	4.369E-12	.262	1.505E-11	.127	1.920E-11	.107
15	1.965E-12	.271	9.358E-12	.126	1.303E-11	.100
16	4.080E-13	.462	4.202E-12	.160	5.054E-12	.142
17	4.688E-13	.450	3.400E-12	.159	5.651E-12	.130
18	4.203E-13	.644	2.819E-12	.178	4.998E-12	.133
19	1.747E-14	1.000	1.949E-12	.197	5.534E-12	.129
20	0.	0.000	3.704E-12	.343	9.155E-12	.187
21	0.	0.000	2.190E-12	.958	2.224E-12	.944

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.527E-10	.118	1.789E-10	.118	1.624E-10	.114
2	1.555E-10	.111	1.756E-10	.104	1.236E-10	.114
3	1.424E-10	.116	1.302E-10	.128	1.217E-10	.131
4	1.087E-10	.144	1.493E-10	.137	8.734E-11	.157
5	8.721E-11	.160	1.104E-10	.131	9.019E-11	.160
6	5.292E-11	.182	1.039E-10	.137	6.224E-11	.161
7	6.686E-11	.172	7.977E-11	.156	5.663E-11	.181
8	4.506E-11	.179	7.852E-11	.169	5.528E-11	.196
9	4.121E-11	.135	7.917E-11	.107	4.529E-11	.150
10	3.562E-11	.170	4.713E-11	.147	2.620E-11	.184
11	1.789E-11	.208	5.192E-11	.123	2.200E-11	.220
12	1.596E-11	.161	3.477E-11	.105	2.337E-11	.152
13	9.663E-12	.177	1.476E-11	.137	1.452E-11	.134
14	4.767E-12	.255	1.381E-11	.128	7.211E-12	.178
15	3.346E-12	.180	7.007E-12	.173	3.978E-12	.184
16	1.363E-12	.270	3.764E-12	.174	1.927E-12	.218
17	9.780E-13	.311	1.961E-12	.219	2.213E-12	.210
18	6.692E-13	.342	3.095E-12	.152	1.542E-12	.284
19	3.341E-13	.467	3.067E-12	.172	4.895E-13	.414
20	4.344E-13	.966	8.242E-13	.607	1.035E-12	.600
21	0.	0.000	2.098E-12	1.000	0.	0.000

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ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	2.514E-10	.097	2.514E-10	.080	2.332E-10	.091
2	1.767E-10	.100	2.040E-10	.103	1.885E-10	.103
3	1.795E-10	.107	1.296E-10	.125	1.572E-10	.105
4	1.154E-10	.135	1.498E-10	.107	1.616E-10	.104
5	1.431E-10	.115	1.155E-10	.124	1.264E-10	.124
6	1.081E-10	.124	1.386E-10	.120	1.150E-10	.140
7	9.055E-11	.138	9.539E-11	.162	8.356E-11	.152
8	6.672E-11	.188	7.465E-11	.166	6.570E-11	.197
9	5.182E-11	.133	6.290E-11	.128	7.156E-11	.121
10	4.975E-11	.147	6.621E-11	.122	5.572E-11	.120
11	3.555E-11	.165	4.110E-11	.145	4.140E-11	.172
12	3.167E-11	.127	3.724E-11	.107	2.686E-11	.104
13	1.752E-11	.142	3.002E-11	.103	1.655E-11	.128
14	1.119E-11	.136	2.230E-11	.144	1.243E-11	.138
15	9.197E-12	.132	1.202E-11	.115	6.353E-12	.145
16	5.608E-12	.134	6.291E-12	.116	4.959E-12	.147
17	3.686E-12	.166	4.418E-12	.187	3.805E-12	.171
18	3.656E-12	.179	5.753E-12	.132	2.907E-12	.177
19	4.410E-12	.143	4.935E-12	.128	4.208E-12	.153
20	2.742E-12	.358	3.653E-12	.292	2.668E-12	.361
21	0.	0.000	4.196E-12	.705	0.	0.000

ENERGY	BIN 4		BIN 5		BIN 6	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	2.251E-10	.088	2.418E-10	.090	2.406E-10	.103
2	1.225E-10	.121	1.966E-10	.099	1.883E-10	.107
3	1.330E-10	.120	1.308E-10	.116	1.496E-10	.113
4	1.419E-10	.118	1.471E-10	.104	1.582E-10	.111
5	9.631E-11	.152	1.145E-10	.133	1.447E-10	.117
6	1.020E-10	.138	9.418E-11	.150	1.424E-10	.125
7	7.697E-11	.156	7.933E-11	.179	8.662E-11	.165
8	6.015E-11	.171	8.304E-11	.146	8.725E-11	.161
9	4.873E-11	.153	6.355E-11	.111	7.355E-11	.108
10	4.678E-11	.143	5.431E-11	.124	5.153E-11	.155
11	3.443E-11	.154	3.556E-11	.168	3.365E-11	.177
12	2.272E-11	.130	3.092E-11	.115	3.234E-11	.111
13	1.311E-11	.168	2.012E-11	.132	2.983E-11	.131
14	7.429E-12	.197	1.158E-11	.148	1.502E-11	.115
15	6.076E-12	.137	7.736E-12	.129	1.359E-11	.112
16	3.417E-12	.165	5.051E-12	.141	8.079E-12	.110
17	2.617E-12	.191	3.896E-12	.147	6.323E-12	.140
18	1.259E-12	.271	3.648E-12	.151	5.841E-12	.122
19	1.424E-12	.231	2.223E-12	.188	6.419E-12	.114
20	1.107E-12	.544	2.539E-12	.352	6.145E-12	.260
21	0.	0.000	2.664E-13	1.000	5.328E-13	.705

ENERGY GROUP	BIN 7 RESPONSE	FSD	BIN 8 RESPONSE	FSD	BIN 9 RESPONSE	FSD
1	2.013E-10	.100	1.752E-10	.103	2.200E-10	.102
2	1.606E-10	.113	1.704E-10	.104	1.796E-10	.102
3	1.160E-10	.129	1.269E-10	.129	1.366E-10	.115
4	1.179E-10	.124	1.374E-10	.126	1.340E-10	.126
5	1.029E-10	.125	1.085E-10	.130	9.686E-11	.130
6	9.345E-11	.145	8.581E-11	.141	1.239E-10	.126
7	8.797E-11	.156	7.165E-11	.153	8.889E-11	.142
8	5.276E-11	.184	7.021E-11	.162	9.601E-11	.130
9	5.167E-11	.134	4.942E-11	.145	4.878E-11	.156
10	4.807E-11	.136	2.378E-11	.185	4.936E-11	.140
11	3.468E-11	.180	3.001E-11	.154	4.274E-11	.156
12	1.922E-11	.148	2.058E-11	.166	2.667E-11	.118
13	1.599E-11	.133	1.288E-11	.154	2.147E-11	.129
14	6.063E-12	.190	6.766E-12	.171	1.368E-11	.125
15	6.416E-12	.169	3.353E-12	.281	8.452E-12	.139
16	1.424E-12	.262	2.031E-12	.215	4.179E-12	.161
17	2.443E-12	.197	1.892E-12	.250	4.344E-12	.152
18	1.430E-12	.235	1.249E-12	.286	3.450E-12	.164
19	1.644E-12	.273	5.556E-13	.333	4.392E-12	.132
20	1.232E-12	.528	4.196E-13	1.000	5.283E-12	.265
21	0.	0.000	0.	0.000	0.	0.000

ENERGY GROUP	BIN 10 RESPONSE	FSD	BIN 11 RESPONSE	FSD	BIN 12 RESPONSE	FSD
1	1.918E-10	.098	1.800E-10	.098	1.638E-10	.118
2	1.684E-10	.111	1.493E-10	.110	1.150E-10	.130
3	1.644E-10	.102	1.062E-10	.130	7.758E-11	.153
4	1.284E-10	.128	8.695E-11	.141	9.843E-11	.138
5	1.413E-10	.116	9.693E-11	.144	8.198E-11	.140
6	8.161E-11	.145	7.354E-11	.156	6.567E-11	.173
7	9.823E-11	.137	7.694E-11	.158	4.245E-11	.189
8	6.554E-11	.169	4.967E-11	.161	5.017E-11	.176
9	4.918E-11	.139	4.635E-11	.141	3.740E-11	.164
10	5.088E-11	.122	3.217E-11	.173	3.985E-11	.166
11	3.591E-11	.159	2.583E-11	.182	1.779E-11	.214
12	2.423E-11	.133	1.444E-11	.177	1.470E-11	.167
13	1.983E-11	.143	8.585E-12	.212	1.280E-11	.172
14	1.074E-11	.149	3.677E-12	.234	5.931E-12	.184
15	5.077E-12	.154	2.006E-12	.393	3.565E-12	.258
16	4.876E-12	.143	8.573E-13	.323	2.040E-12	.222
17	3.113E-12	.178	7.079E-13	.368	8.140E-13	.341
18	2.439E-12	.209	8.094E-13	.332	1.077E-12	.282
19	2.912E-12	.178	6.693E-14	.726	1.424E-12	.251
20	2.858E-12	.338	0.	0.000	4.371E-13	.527
21	0.	0.000	0.	0.000	0.	0.000

(γ-γ)

REFERENCE MAN

ENERGY GROUP	BIN 1 RESPONSE	FSD	BIN 2 RESPONSE	FSD	BIN 3 RESPONSE	FSD
1	1.842E-10	.107	2.098E-10	.099	1.734E-10	.103
2	1.196E-10	.126	1.631E-10	.107	1.497E-10	.113
3	1.186E-10	.129	1.510E-10	.119	1.246E-10	.118
4	9.253E-11	.144	1.283E-10	.121	1.032E-10	.130
5	8.794E-11	.148	1.132E-10	.136	1.017E-10	.128
6	7.162E-11	.168	9.977E-11	.138	8.619E-11	.145
7	5.977E-11	.181	8.066E-11	.151	6.094E-11	.172
8	4.976E-11	.186	6.352E-11	.161	5.546E-11	.180
9	4.393E-11	.143	5.231E-11	.134	5.083E-11	.143
10	3.456E-11	.175	4.889E-11	.139	3.678E-11	.158
11	2.840E-11	.185	3.564E-11	.159	3.073E-11	.183
12	1.779E-11	.158	2.523E-11	.126	1.940E-11	.153
13	1.159E-11	.200	1.895E-11	.146	1.279E-11	.186
14	6.064E-12	.227	1.166E-11	.179	8.436E-12	.195
15	4.132E-12	.301	7.594E-12	.182	3.758E-12	.225
16	2.131E-12	.245	3.752E-12	.162	2.064E-12	.214
17	1.419E-12	.310	3.142E-12	.187	2.152E-12	.230
18	1.517E-12	.299	2.895E-12	.200	1.134E-12	.318
19	1.079E-12	.370	2.262E-12	.232	9.860E-13	.369
20	7.370E-13	.718	1.620E-12	.558	4.020E-13	.845
21	9.349E-13	.683	5.318E-13	.643	2.882E-13	.852

ENERGY GROUP	BIN 4 RESPONSE	FSD	BIN 5 RESPONSE	FSD	BIN 6 RESPONSE	FSD
1	2.144E-10	.094	2.121E-10	.098	2.213E-10	.092
2	1.794E-10	.106	1.828E-10	.105	1.598E-10	.107
3	1.564E-10	.113	1.365E-10	.120	1.337E-10	.122
4	1.309E-10	.121	1.180E-10	.132	1.194E-10	.126
5	1.199E-10	.128	1.272E-10	.123	1.140E-10	.127
6	1.042E-10	.135	1.139E-10	.129	9.392E-11	.143
7	8.616E-11	.150	8.834E-11	.143	8.126E-11	.147
8	8.517E-11	.153	6.837E-11	.166	5.828E-11	.173
9	6.351E-11	.122	5.677E-11	.128	5.785E-11	.131
10	5.576E-11	.125	5.123E-11	.136	4.774E-11	.134
11	4.126E-11	.154	3.871E-11	.155	3.953E-11	.144
12	2.772E-11	.133	2.852E-11	.127	2.633E-11	.131
13	2.069E-11	.139	2.135E-11	.132	2.066E-11	.159
14	1.399E-11	.133	1.396E-11	.139	1.240E-11	.165
15	8.332E-12	.150	8.419E-12	.161	6.039E-12	.170
16	4.420E-12	.157	4.881E-12	.141	4.478E-12	.153
17	3.473E-12	.173	3.596E-12	.174	2.857E-12	.187
18	3.248E-12	.169	3.337E-12	.172	2.151E-12	.235
19	2.612E-12	.178	3.000E-12	.180	1.536E-12	.261
20	1.797E-12	.530	1.516E-12	.566	9.330E-13	.379
21	8.260E-13	.859	8.529E-13	.683	7.059E-14	.981

ENERGY	BIN 7		BIN 8		BIN 9	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.866E-10	.103	2.378E-10	.094	2.082E-10	.093
2	1.462E-10	.109	1.737E-10	.108	1.648E-10	.111
3	1.210E-10	.118	1.474E-10	.115	1.403E-10	.115
4	1.153E-10	.127	1.393E-10	.124	1.222E-10	.125
5	1.122E-10	.122	1.213E-10	.125	1.019E-10	.138
6	1.013E-10	.129	1.025E-10	.141	9.291E-11	.136
7	7.298E-11	.151	8.156E-11	.153	7.769E-11	.145
8	5.008E-11	.188	7.271E-11	.154	6.313E-11	.169
9	5.169E-11	.136	6.392E-11	.122	5.420E-11	.129
10	3.550E-11	.155	4.898E-11	.141	3.978E-11	.151
11	2.433E-11	.199	4.255E-11	.148	3.152E-11	.171
12	2.108E-11	.154	2.862E-11	.124	2.061E-11	.147
13	1.170E-11	.224	2.014E-11	.132	1.690E-11	.147
14	7.697E-12	.202	1.730E-11	.138	9.493E-12	.166
15	4.658E-12	.198	8.835E-12	.135	5.949E-12	.162
16	2.167E-12	.205	5.520E-12	.134	3.626E-12	.167
17	1.662E-12	.252	4.930E-12	.146	2.668E-12	.224
18	1.637E-12	.261	3.567E-12	.155	1.814E-12	.244
19	7.158E-13	.369	3.329E-12	.168	1.665E-12	.270
20	2.499E-13	.837	2.265E-12	.471	8.471E-13	.707
21	0.	0.000	7.112E-13	.593	4.310E-13	.982

ENERGY	BIN 10		BIN 11		BIN 12	
GROUP	RESPONSE	FSD	RESPONSE	FSD	RESPONSE	FSD
1	1.825E-10	.100	2.259E-10	.089	1.643E-10	.102
2	1.412E-10	.120	1.660E-10	.107	1.255E-10	.122
3	1.141E-10	.137	1.407E-10	.121	9.606E-11	.143
4	9.718E-11	.138	1.353E-10	.119	8.218E-11	.153
5	9.650E-11	.138	1.274E-10	.118	8.303E-11	.142
6	8.450E-11	.142	9.768E-11	.142	6.132E-11	.163
7	6.999E-11	.155	8.606E-11	.156	5.500E-11	.177
8	5.069E-11	.182	7.633E-11	.152	4.056E-11	.205
9	4.352E-11	.148	5.731E-11	.128	3.820E-11	.160
10	3.743E-11	.152	5.089E-11	.134	2.710E-11	.176
11	2.571E-11	.197	3.799E-11	.159	1.726E-11	.231
12	1.685E-11	.154	3.016E-11	.122	1.199E-11	.194
13	9.486E-12	.196	1.952E-11	.136	9.568E-12	.267
14	5.797E-12	.206	1.091E-11	.157	4.939E-12	.256
15	3.504E-12	.257	6.886E-12	.159	2.028E-12	.277
16	1.993E-12	.215	4.350E-12	.151	1.213E-12	.291
17	1.115E-12	.309	3.892E-12	.161	1.079E-12	.369
18	9.789E-13	.349	2.986E-12	.188	9.418E-13	.314
19	6.633E-13	.459	2.015E-12	.219	5.906E-13	.396
20	2.528E-13	.850	1.171E-12	.688	2.718E-13	.752
21	0.	0.000	1.841E-13	.850	0.	0.000

POLAR ANGLE-DIFFERENTIAL DOSE

DEPOSITION FACTORS FOR REFERENCE MAN

Neutron Dose Deposition From Incident Neutron Fluence (n-n)

ENERGY GROUP	BAND 1 RESPONSE	BAND 2 RESPONSE	BAND 3 RESPONSE
1	2.867E-10*	4.568E-10	4.692E-10
2	2.615E-10	4.041E-10	4.519E-10
3	2.400E-10	3.643E-10	4.089E-10
4	2.605E-10	3.949E-10	4.228E-10
5	2.606E-10	3.799E-10	4.127E-10
6	2.664E-10	3.647E-10	4.160E-10
7	2.528E-10	3.598E-10	3.835E-10
8	2.173E-10	3.330E-10	3.438E-10
9	1.761E-10	3.226E-10	3.590E-10
10	1.980E-10	3.009E-10	3.246E-10
11	2.079E-10	2.969E-10	3.164E-10
12	1.667E-10	2.656E-10	2.983E-10
13	1.553E-10	2.401E-10	2.622E-10
14	1.298E-10	2.117E-10	2.388E-10
15	1.327E-10	1.890E-10	2.150E-10
16	1.256E-10	1.496E-10	1.716E-10
17	9.411E-11	1.397E-10	1.452E-10
18	7.466E-11	1.119E-10	1.457E-10
19	4.525E-11	9.839E-11	1.138E-10
20	4.699E-11	8.085E-11	1.083E-10
21	2.722E-11	4.874E-11	5.018E-11
22	1.252E-11	2.089E-11	1.843E-11
23	5.078E-12	8.909E-12	1.137E-11
24	3.593E-12	8.024E-12	5.444E-12
25	9.790E-13	4.058E-12	5.337E-12
26	1.536E-12	2.418E-12	1.955E-12
27	1.001E-12	4.348E-12	1.746E-12
28	2.951E-13	2.435E-12	8.741E-13
29	1.159E-13	3.426E-13	2.059E-12
30	1.892E-13	6.730E-13	3.603E-12
31	1.722E-12	1.947E-12	1.079E-12
32	1.087E-13	1.438E-12	1.345E-12
33	9.070E-13	1.514E-12	1.217E-12
34	5.087E-13	9.602E-13	1.902E-12
35	3.140E-13	1.117E-12	7.482E-13
36	1.161E-12	1.750E-12	1.494E-12
37	3.303E-13	5.942E-13	7.357E-13

* rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BAND 4 RESPONSE	BAND 5 RESPONSE
1	4.177E-10	2.114E-10
2	3.833E-10	2.058E-10
3	3.680E-10	1.894E-10
4	3.591E-10	1.714E-10
5	3.488E-10	1.609E-10
6	3.450E-10	1.859E-10
7	3.399E-10	1.768E-10
8	3.250E-10	1.522E-10
9	3.045E-10	1.334E-10
10	2.693E-10	1.348E-10
11	2.617E-10	1.148E-10
12	2.638E-10	1.179E-10
13	2.048E-10	1.127E-10
14	1.881E-10	8.124E-11
15	1.890E-10	6.743E-11
16	1.358E-10	5.902E-11
17	1.035E-10	4.229E-11
18	1.164E-10	3.713E-11
19	9.289E-11	2.614E-11
20	6.014E-11	2.499E-11
21	3.384E-11	1.034E-11
22	1.549E-11	5.922E-12
23	6.293E-12	1.286E-12
24	4.297E-12	9.167E-13
25	2.913E-12	1.110E-12
26	1.056E-12	3.690E-13
27	1.706E-12	2.379E-13
28	2.543E-13	1.008E-12
29	9.603E-13	2.160E-15
30	9.470E-13	1.346E-14
31	1.153E-12	0.
32	2.015E-12	1.650E-13
33	6.984E-13	0.
34	5.365E-13	2.020E-15
35	1.742E-13	1.334E-13
36	1.229E-12	5.365E-15
37	3.967E-13	2.320E-13

POLAR ANGLE-DIFFERENTIAL DOSE DEPOSITION FACTORS FOR REFERENCE MAN

Gamma Ray Dose Deposition From Incident Neutron Fluence (n-γ)

ENERGY GROUP	BAND 1 RESPONSE	BAND 2 RESPONSE	BAND 3 RESPONSE
1	1.168E-11*	1.630E-11	1.779E-11
2	1.226E-11	1.584E-11	1.876E-11
3	1.362E-11	1.809E-11	2.176E-11
4	8.834E-12	2.433E-11	2.032E-11
5	1.145E-11	1.810E-11	2.282E-11
6	1.113E-11	2.032E-11	1.993E-11
7	9.261E-12	1.999E-11	2.398E-11
8	1.228E-11	1.626E-11	2.442E-11
9	9.137E-12	1.719E-11	2.107E-11
10	1.178E-11	1.574E-11	1.966E-11
11	1.129E-11	1.470E-11	1.813E-11
12	9.762E-12	1.276E-11	1.441E-11
13	5.188E-12	1.012E-11	1.408E-11
14	5.962E-12	1.280E-11	1.593E-11
15	4.468E-12	1.059E-11	1.596E-11
16	6.072E-12	1.036E-11	1.795E-11
17	7.171E-12	1.073E-11	1.685E-11
18	4.511E-12	1.355E-11	1.745E-11
19	8.729E-12	1.337E-11	1.498E-11
20	5.242E-12	1.693E-11	1.548E-11
21	6.428E-12	1.272E-11	1.718E-11
22	5.308E-12	1.213E-11	1.627E-11
23	3.708E-12	1.083E-11	1.544E-11
24	6.003E-12	1.161E-11	1.690E-11
25	6.958E-12	1.067E-11	1.497E-11
26	4.924E-12	1.280E-11	1.316E-11
27	7.403E-12	1.377E-11	1.525E-11
28	5.095E-12	1.085E-11	1.308E-11
29	1.336E-11	1.286E-11	1.556E-11
30	6.506E-12	1.150E-11	1.629E-11
31	3.871E-12	1.165E-11	1.582E-11
32	3.895E-12	1.165E-11	1.441E-11
33	1.022E-11	1.378E-11	1.618E-11
34	7.995E-12	1.241E-11	1.484E-11
35	3.062E-12	1.049E-11	1.827E-11
36	4.265E-12	1.152E-11	1.400E-11
37	3.246E-12	5.586E-12	5.706E-12

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BAND 4 RESPONSE	BAND 5 RESPONSE
1	1.631E-11	9.340E-12
2	1.700E-11	8.335E-12
3	2.271E-11	8.266E-12
4	1.774E-11	1.078E-11
5	2.081E-11	1.164E-11
6	1.690E-11	1.211E-11
7	1.882E-11	1.259E-11
8	1.877E-11	1.350E-11
9	1.544E-11	1.244E-11
10	1.673E-11	9.820E-12
11	1.307E-11	8.236E-12
12	1.243E-11	4.743E-12
13	1.150E-11	5.926E-12
14	1.151E-11	7.576E-12
15	1.150E-11	3.767E-12
16	1.063E-11	5.661E-12
17	1.302E-11	2.948E-12
18	1.326E-11	4.824E-12
19	1.274E-11	7.298E-12
20	1.191E-11	4.511E-12
21	1.483E-11	4.695E-12
22	1.107E-11	2.911E-12
23	8.897E-12	5.040E-12
24	9.250E-12	3.198E-12
25	1.044E-11	2.900E-12
26	8.602E-12	3.133E-12
27	7.567E-12	3.909E-12
28	9.815E-12	7.823E-13
29	9.454E-12	4.912E-12
30	8.363E-12	5.967E-12
31	9.137E-12	3.046E-12
32	1.240E-11	4.880E-12
33	1.059E-11	2.824E-12
34	1.082E-11	3.650E-12
35	1.399E-11	2.140E-12
36	5.475E-12	3.660E-13
37	4.810E-12	1.365E-12

POLAR ANGLE-DIFFERENTIAL DOSE DEPOSITION

FACTORS FOR REFERENCE MAN

Total Dose Deposition From Incident Neutron Fluenct (n-t)

ENERGY GROUP	BAND 1 RESPONSE	BAND 2 RESPONSE	BAND 3 RESPONSE
1	3.443E-10*	4.605E-10	4.800E-10
2	2.718E-10	4.263E-10	4.983E-10
3	2.642E-10	3.907E-10	4.228E-10
4	2.840E-10	4.013E-10	4.449E-10
5	2.755E-10	3.929E-10	4.287E-10
6	2.833E-10	3.876E-10	4.365E-10
7	2.442E-10	3.674E-10	4.136E-10
8	2.095E-10	3.488E-10	3.737E-10
9	1.738E-10	3.288E-10	3.828E-10
10	2.193E-10	3.182E-10	3.327E-10
11	2.090E-10	2.888E-10	3.249E-10
12	1.600E-10	2.721E-10	3.042E-10
13	1.411E-10	2.579E-10	2.704E-10
14	1.296E-10	2.224E-10	2.599E-10
15	1.314E-10	2.183E-10	2.331E-10
16	1.101E-10	1.607E-10	1.935E-10
17	8.805E-11	1.520E-10	1.478E-10
18	8.191E-11	1.191E-10	1.545E-10
19	7.468E-11	1.146E-10	1.448E-10
20	4.181E-11	9.164E-11	1.314E-10
21	3.551E-11	5.611E-11	6.664E-11
22	1.816E-11	3.014E-11	3.458E-11
23	1.226E-11	1.846E-11	2.692E-11
24	9.506E-12	1.787E-11	2.216E-11
25	8.695E-12	1.497E-11	1.922E-11
26	6.006E-12	1.534E-11	1.545E-11
27	7.867E-12	1.800E-11	1.658E-11
28	5.442E-12	1.323E-11	1.401E-11
29	1.470E-11	1.325E-11	1.717E-11
30	6.643E-12	1.251E-11	2.009E-11
31	4.611E-12	1.358E-11	1.723E-11
32	4.078E-12	1.310E-11	1.533E-11
33	1.093E-11	1.491E-11	1.803E-11
34	8.115E-12	1.307E-11	1.700E-11
35	3.505E-12	1.120E-11	1.943E-11
36	4.322E-12	1.246E-11	1.525E-11
37	3.586E-12	6.203E-12	6.413E-12

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BAND 4 RESPONSE	BAND 5 RESPONSE
1	4.340E-10	2.207E-10
2	4.003E-10	2.141E-10
3	3.907E-10	1.977E-10
4	3.768E-10	1.822E-10
5	3.696E-10	1.726E-10
6	3.619E-10	1.980E-10
7	3.587E-10	1.894E-10
8	3.437E-10	1.657E-10
9	3.199E-10	1.458E-10
10	2.860E-10	1.447E-10
11	2.748E-10	1.230E-10
12	2.762E-10	1.226E-10
13	2.163E-10	1.186E-10
14	1.996E-10	8.882E-11
15	2.005E-10	7.119E-11
16	1.464E-10	6.468E-11
17	1.165E-10	4.524E-11
18	1.297E-10	4.196E-11
19	1.056E-10	3.344E-11
20	7.205E-11	2.950E-11
21	4.867E-11	1.503E-11
22	2.656E-11	8.833E-12
23	1.519E-11	6.327E-12
24	1.355E-11	4.115E-12
25	1.335E-11	4.010E-12
26	9.658E-12	3.502E-12
27	9.273E-12	4.147E-12
28	1.007E-11	1.791E-12
29	1.041E-11	4.914E-12
30	9.310E-12	5.981E-12
31	1.029E-11	3.046E-12
32	1.442E-11	5.045E-12
33	1.128E-11	2.824E-12
34	1.136E-11	3.652E-12
35	1.417E-11	2.274E-12
36	6.704E-12	3.713E-13
37	5.207E-12	1.597E-12

POLAR ANGLE-DIFFERENTIAL DOSE DEPOSITION

FACTORS FOR REFERENCE MAN

Gamma Ray Dose Deposition From Incident Gamma Ray Fluence

ENERGY GROUP	BAND 1 RESPONSE	BAND 2 RESPONSE	BAND 3 RESPONSE
1	1.842E-10*	1.992E-10	2.145E-10
2	1.196E-10	1.641E-10	1.656E-10
3	1.186E-10	1.440E-10	1.347E-10
4	9.253E-11	1.208E-10	1.230E-10
5	8.794E-11	1.116E-10	1.187E-10
6	7.162E-11	9.671E-11	1.029E-10
7	5.977E-11	7.592E-11	8.104E-11
8	4.976E-11	6.805E-11	6.236E-11
9	4.393E-11	5.555E-11	5.756E-11
10	3.456E-11	4.714E-11	4.586E-11
11	2.840E-11	3.588E-11	3.628E-11
12	1.779E-11	2.412E-11	2.609E-11
13	1.159E-11	1.747E-11	1.846E-11
14	6.064E-12	1.136E-11	1.284E-11
15	4.132E-12	6.561E-12	6.988E-12
16	2.131E-12	3.412E-12	4.261E-12
17	1.419E-12	2.922E-12	3.261E-12
18	1.517E-12	2.426E-12	2.673E-12
19	1.079E-12	1.953E-12	2.145E-12
20	7.370E-13	1.273E-12	1.241E-12
21	9.349E-13	5.486E-13	4.087E-13

*rad (marrow) per unit fluence per energy group per angle bin

ENERGY GROUP	BAND 4 RESPONSE	BAND 5 RESPONSE
1	2.055E-10	1.643E-10
2	1.573E-10	1.255E-10
3	1.317E-10	9.606E-11
4	1.182E-10	8.218E-11
5	1.086E-10	8.303E-11
6	9.170E-11	6.132E-11
7	7.791E-11	5.500E-11
8	6.338E-11	4.056E-11
9	5.168E-11	3.820E-11
10	4.270E-11	2.710E-11
11	3.174E-11	1.726E-11
12	2.254E-11	1.199E-11
13	1.530E-11	9.568E-12
14	8.733E-12	4.939E-12
15	5.406E-12	2.028E-12
16	3.323E-12	1.213E-12
17	2.558E-12	1.079E-12
18	1.926E-12	9.418E-13
19	1.448E-12	5.906E-13
20	7.570E-13	2.718E-13
21	2.050E-13	0.

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